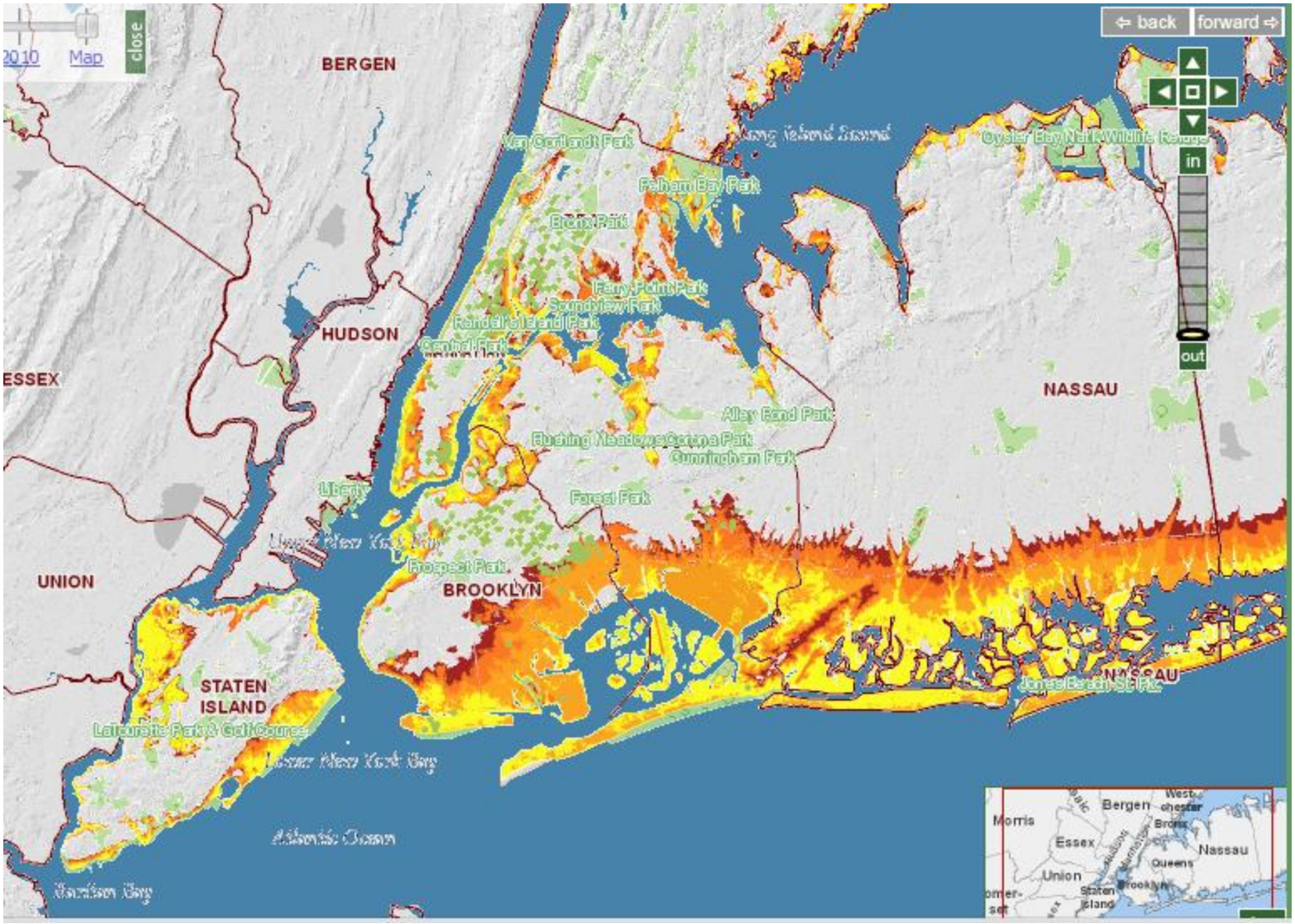
WILL NEW YORK CITY EVER BE SAFE FROM FUTURE FLOODING?

Malcolm J Bowman

School of Marine & Atmospheric Sciences
Stony Brook University

IEEE SusTech 2014
Portland OR



http://www.harborestuary.org/aboutestuary-climatechange-tides.htm

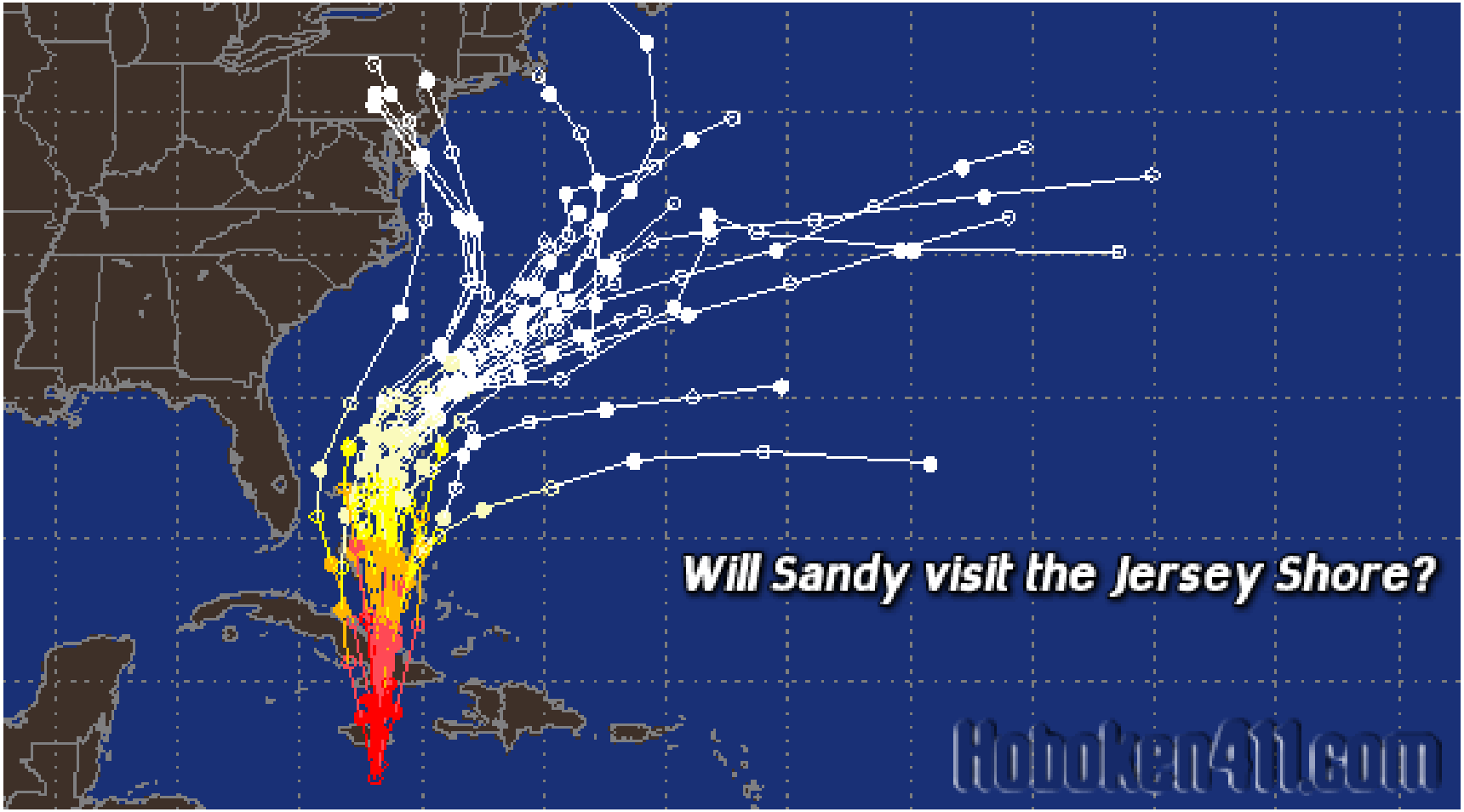
Worst case flooding scenario. Note that the State of NJ does not exist in the eyes of NYC planners. Well it exists, but it does not flood and therefore a regional approach is unneeded!

A maintenance worker attaches plywood to a sidewalk grate at the 2 Broadway building of Lower Manhattan in New York on Sunday in anticipation of the arrival of the megastorm

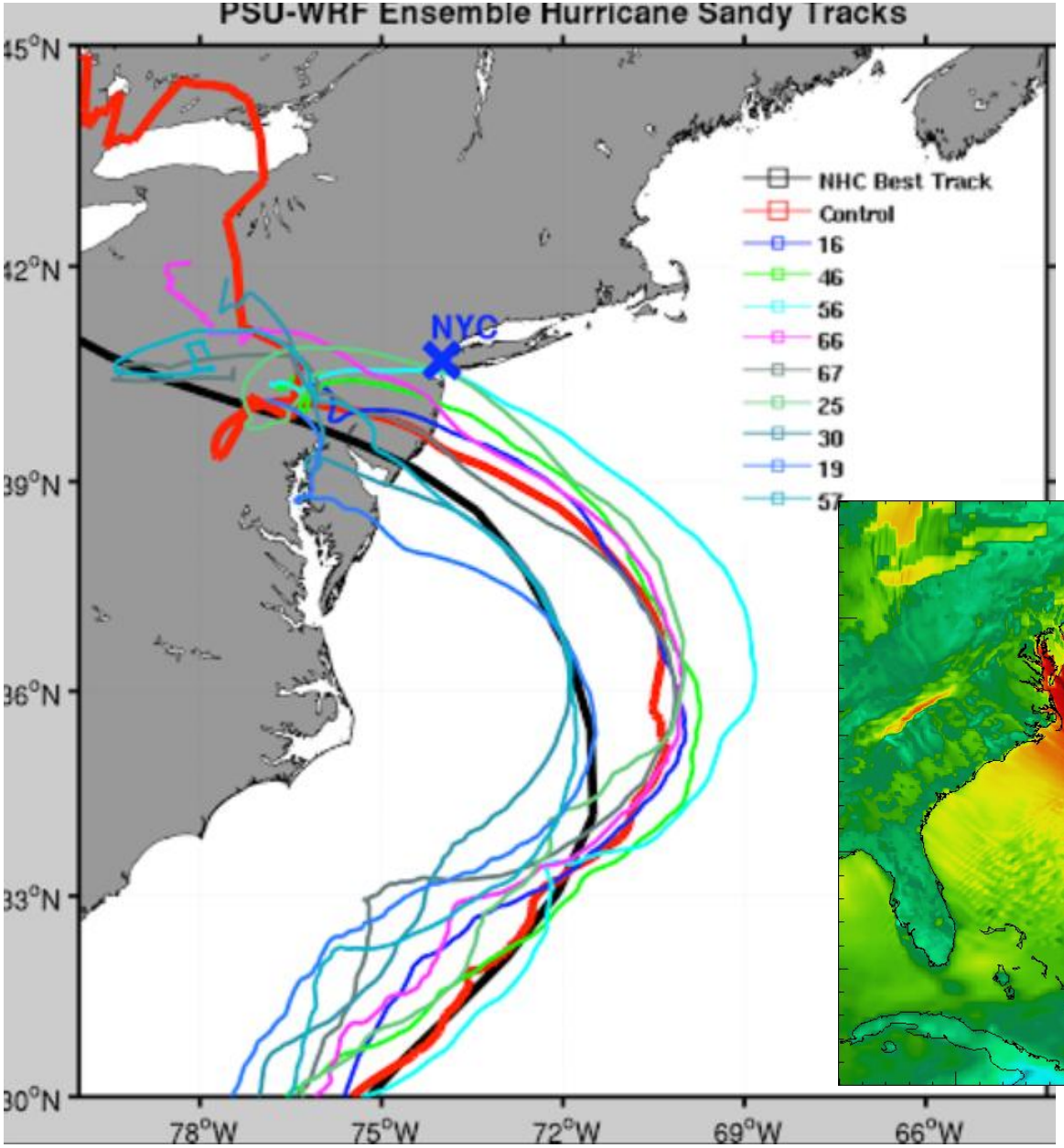
Planning precautions for Sandy- covering over a subway ventilation shaft.

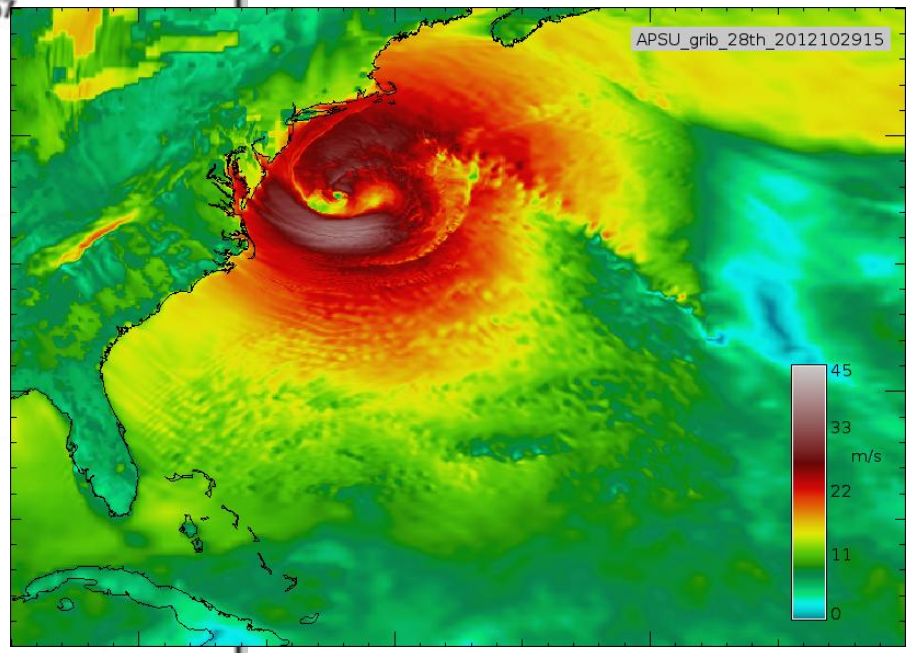
Little activity: A New York police officer guards a closed subway entrance in downtown Manhattan as Hurricane Sandy makes its approach in New York

Bowling Green subway station at The Batttery, Manhattan.

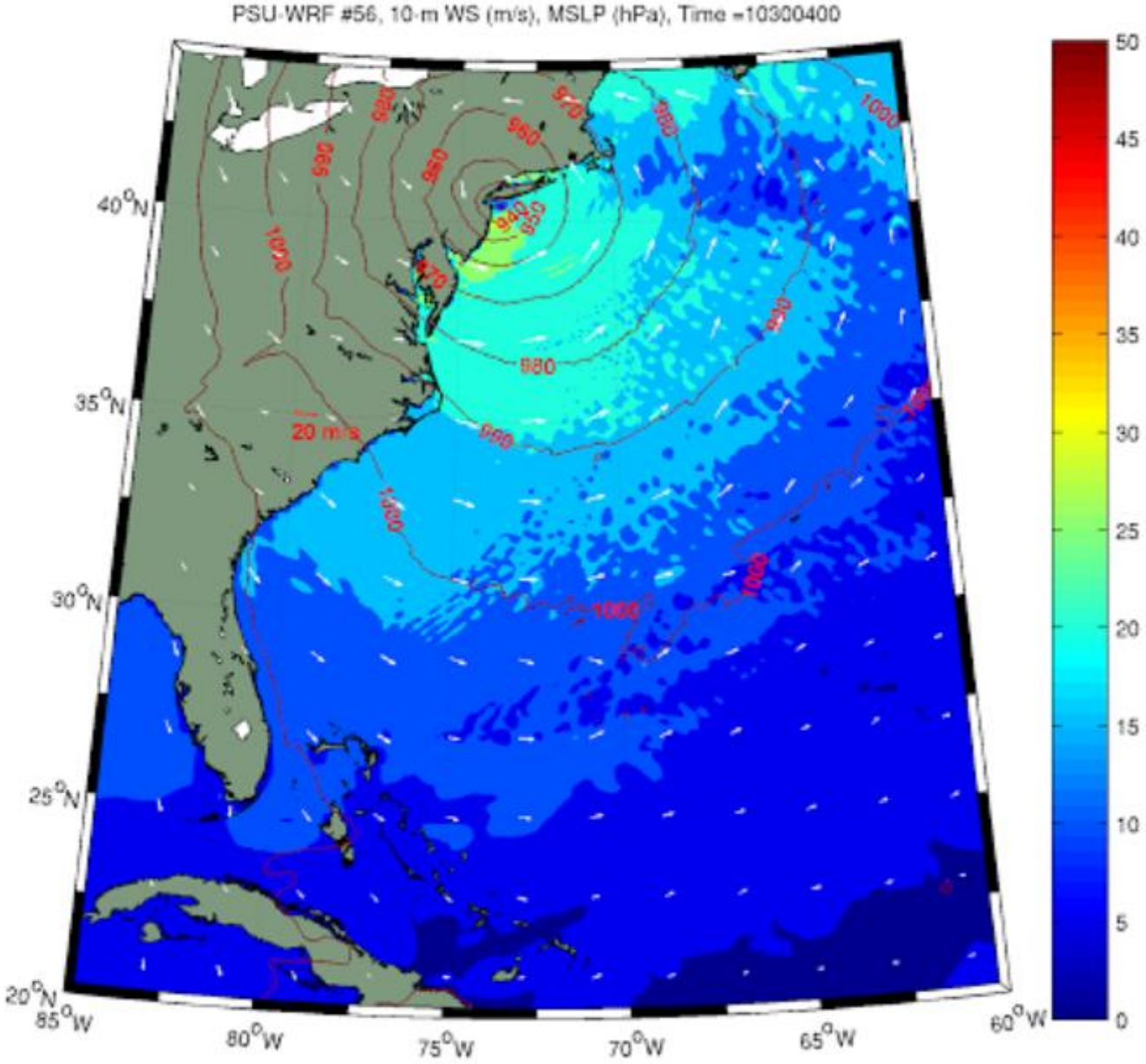


https://www.google.com/search?hl=en&site=&tbm=isch&source=hp&biw=1280&bih=963&q=hurricane+sandy+track&oq=hurricane+sandy+track&gs_l=img.3..0l3j0i24l7.4269.8641.0.9044.21.13.0.8.8.0.39.255.13.13.0...0.0...1ac.1.8.img.UKlaqJJxpKM#imgrc=MDvJRF5f7ZpLuM%3A%3B3hwMByK11BElvM%3Bhttp%253A%252F%252Fblog.weathernationtv.com%252Fwp-content%252Fuploads%252F10.24.12-Sandy-track-more.jpg%3Bhttp%253A%252F%252Fblog.weathernationtv.com%252F2012%252F10%252F24%252Fhurricane-sandy-and-the-potential-of-an-east-coast-landfall%252F%3B692%3B481





Data courtesy of Fuqing Zhang, Penn State U; graphics by Hamish Bowman.

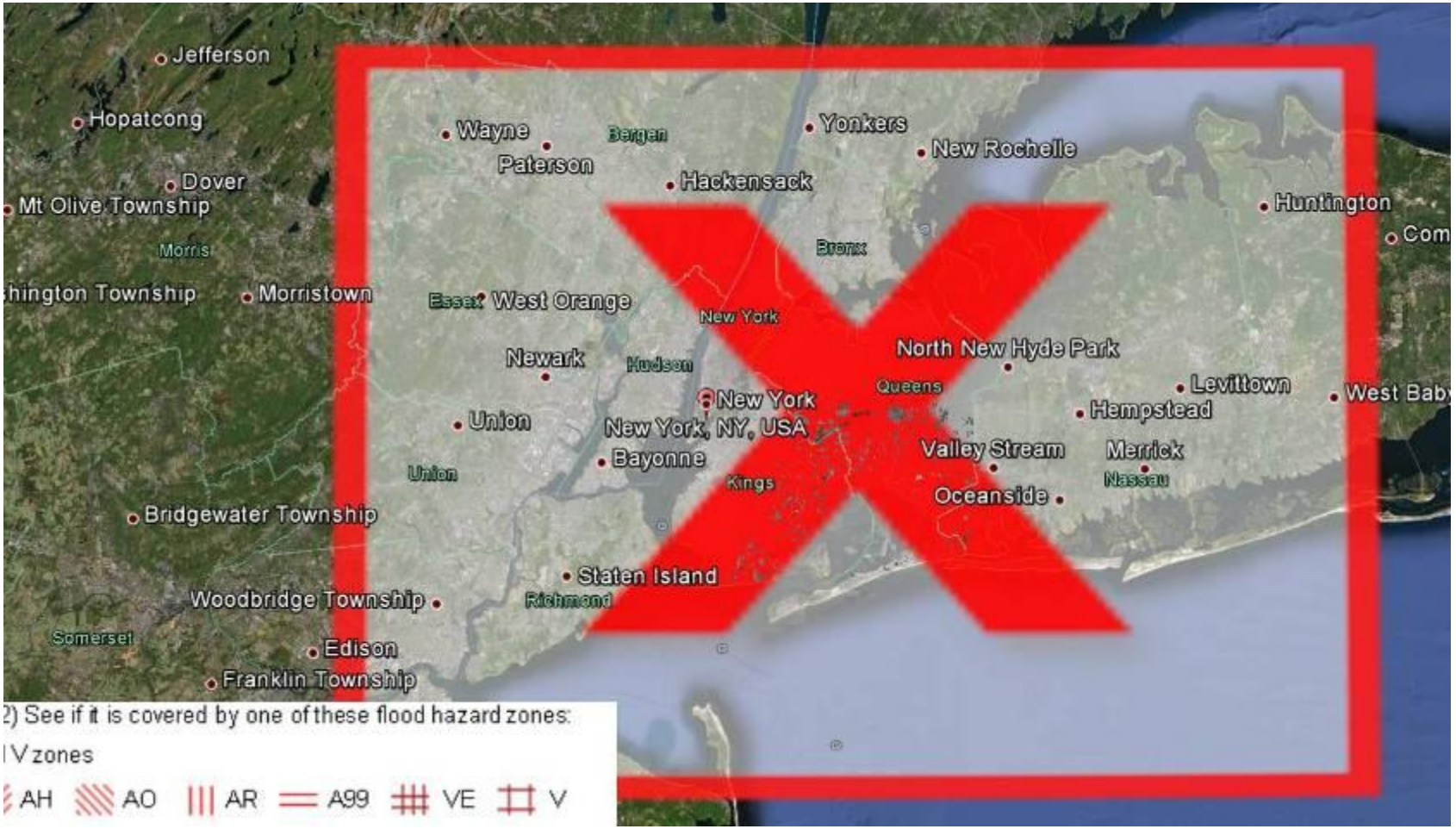

PSU-WRF #56, 10-m WS (m/s), MSLP (hPa), Time =10300400
40°N
35°N
30°N
25°N
20°N
85°W
80°W
75°W
70°W
65°W
60°W
20 m/s
50
45
40
35
30
25
20
15
10
5
0

Ground Zero

Entrance to Brooklyn Battery tunnel under New York Harbor


Mother Nature has not been kind to us.
11/02/2012 10:34


In Memory of
The Angels of Ocean Avenue



https://hazards.fema.gov/femaportal/prelimdownload/searchResult.action

FEMA Map Service Center

Preliminary FEMA Map Products

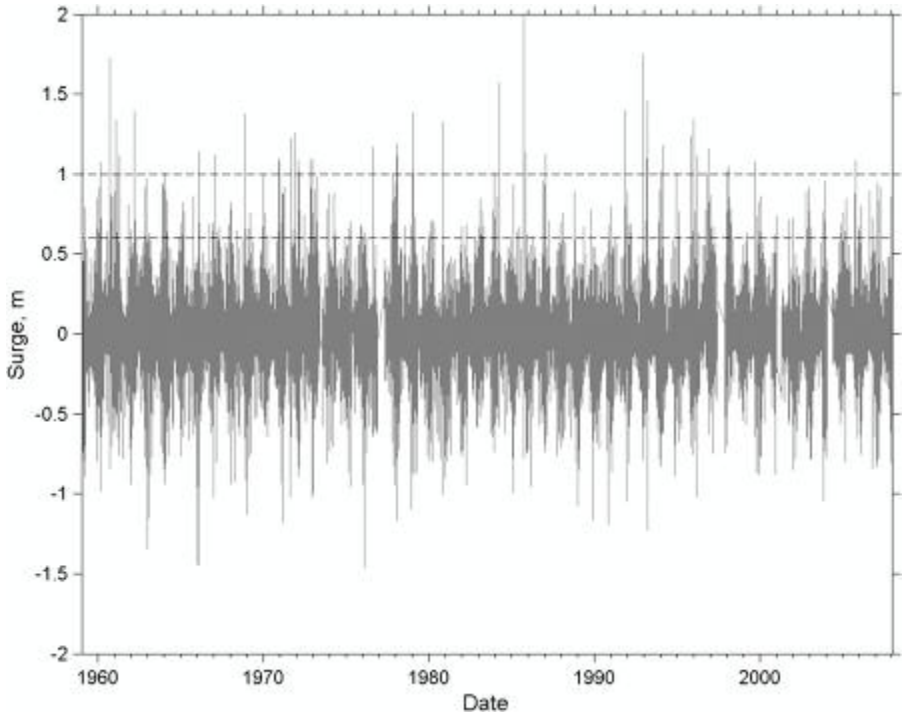


FIG. 2. Time series of the daily maximum positive surge (water level minus astronomical tide) at the Battery (see Fig. 1 for location) between 1959 and 2007. The two dashed lines represent the minor (0.6 m) and moderate (1.0 m) surge thresholds used in this study. From Colle et al, 2010.

TABLE 2. List of the 17 tropical-storm dates (time is UTC) and surges for the NYC area from 1959 to 2007.

Date	Surge (m)
1400 30 Jul 1960	0.64
1800 12 Sep 1960	1.73
1700 22 Oct 1961	0.73
0600 23 Oct 1961	0.64
1000 29 Aug 1971	1.21
1600 22 Jun 1972	0.74
0400 10 Aug 1976	1.17
1900 14 Oct 1977	0.83
1700 27 Sep 1985	2.00
0900 31 Oct 1991	1.40
1600 13 Jul 1996	0.61
0200 9 Oct 1996	0.78
2300 16 Sep 1999	1.07
0900 19 Sep 2003	0.62
1300 25 Oct 2005	1.09
0200 26 Oct 2005	0.65
0000 3 Sep 2006	0.89

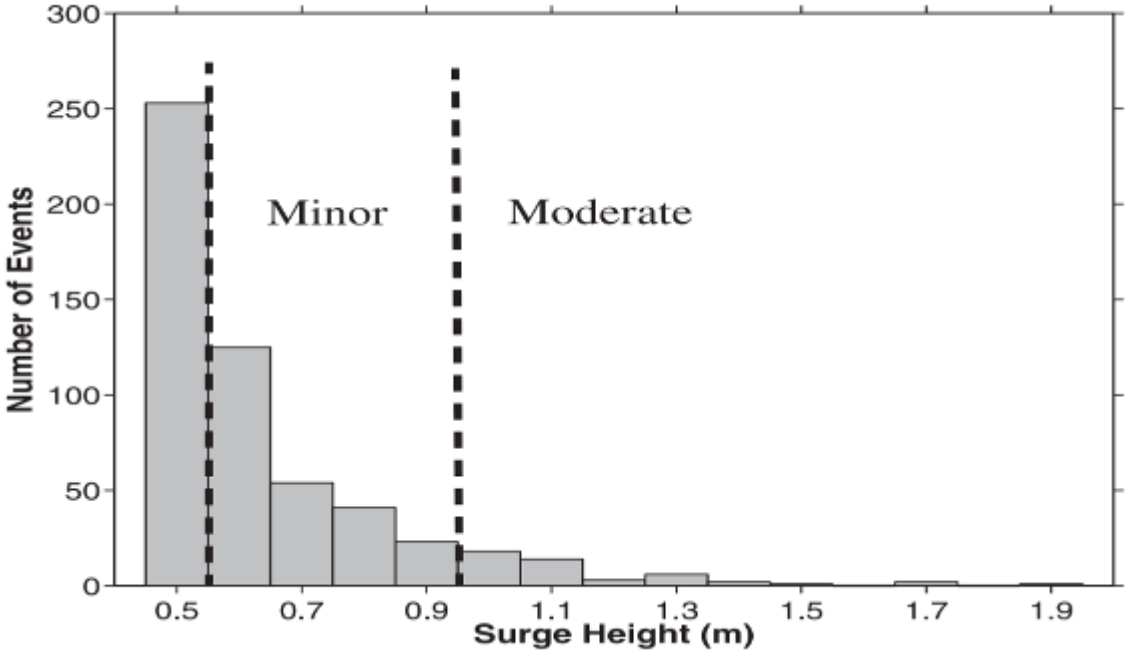


Fig. 6: Frequency histogram of storm surges, starting at 0.5 m at The Battery from 1959 to 2007 (from Colle et al., 2010).

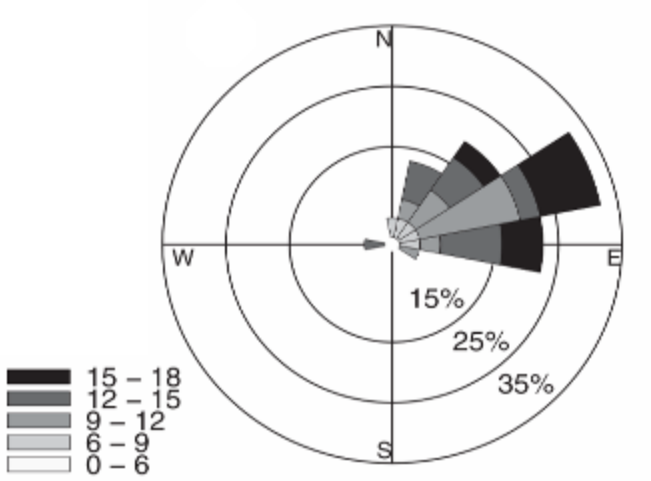


Fig. 8: Surface (10 m) wind-rose plot at JFK/Bennett field airports displaying the frequency of wind direction and speed (shaded; m s-1) at the time of maximum surge at The Battery for all surges greater than 1.0 m between 1959-2007. The wind direction producing maximum surges (~ ENE) is essentially the same as the orientation of Long Island Sound/south shore of Long Island. From Colle et al. (2010).

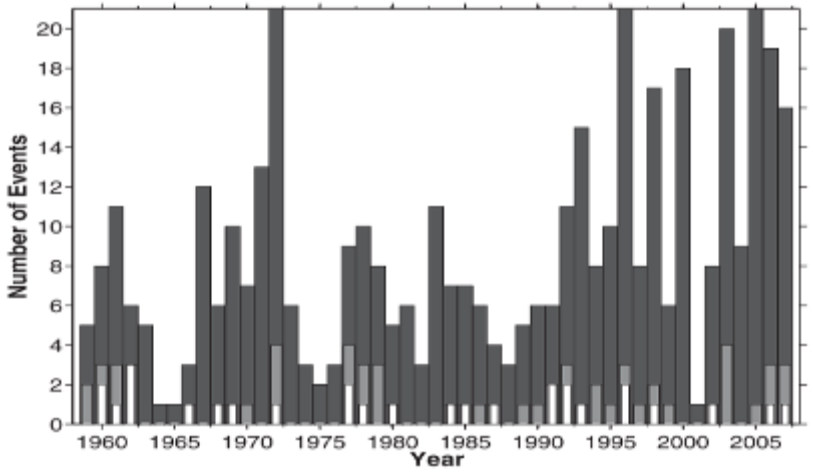
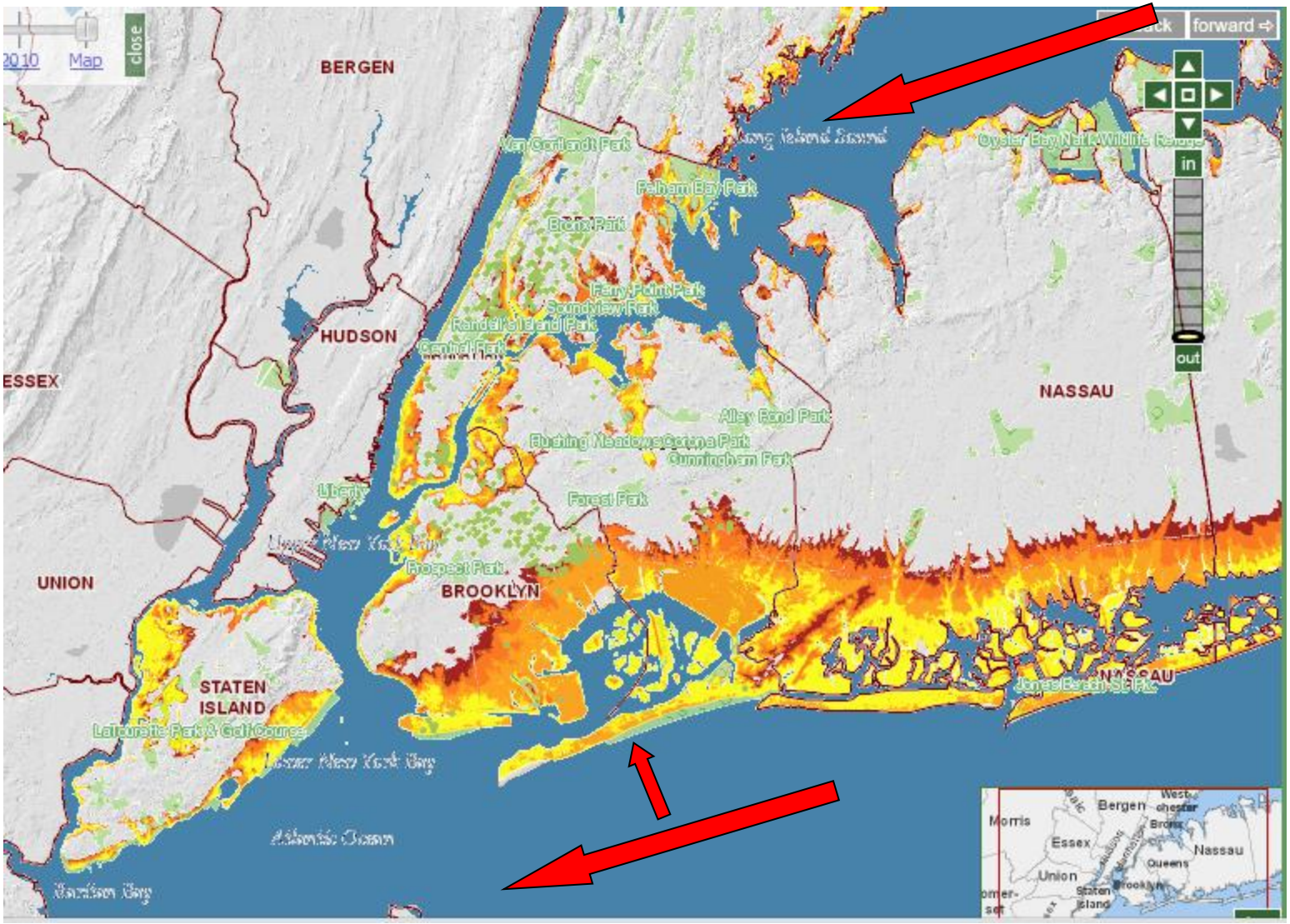
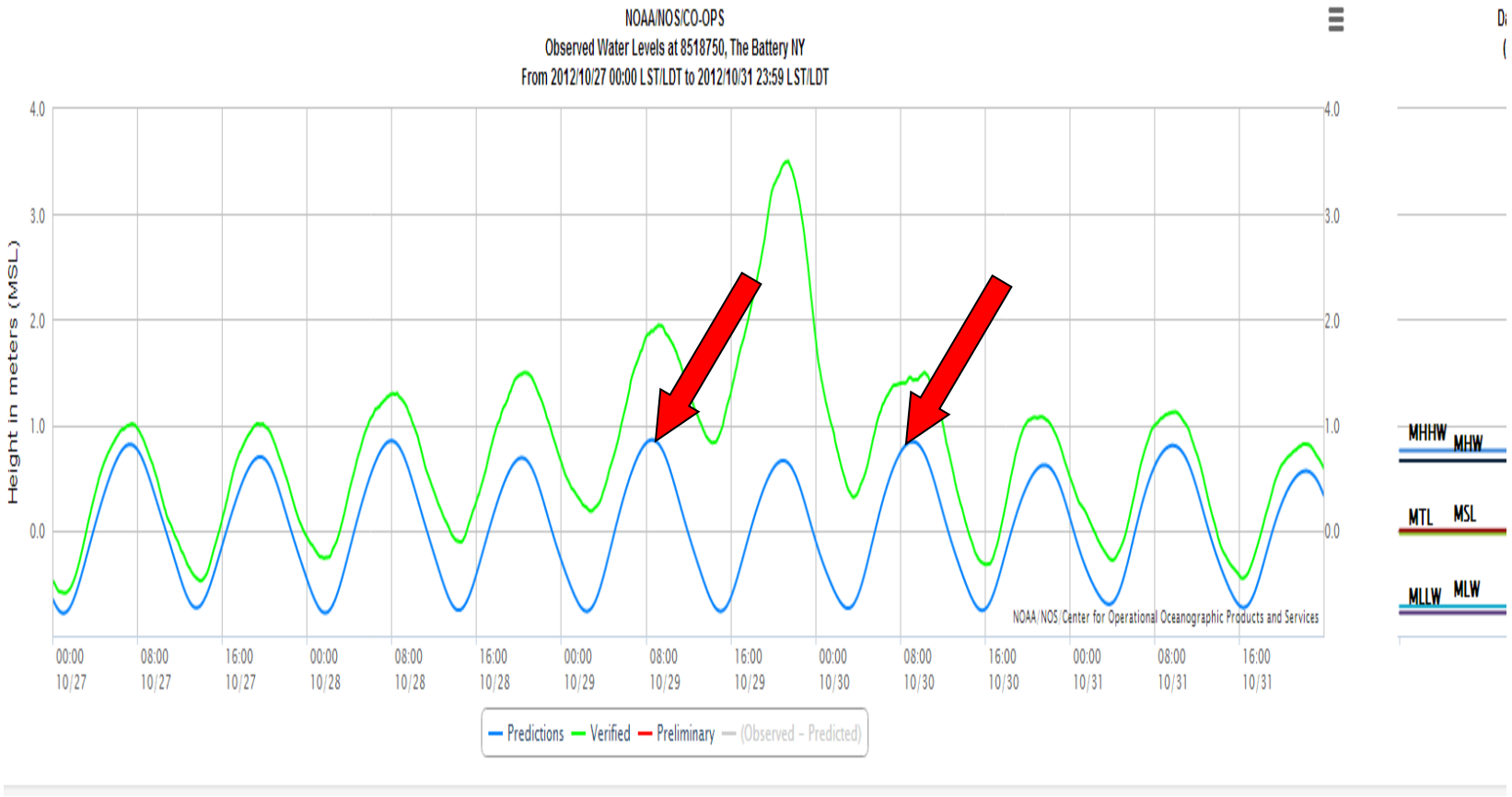


Fig. 7: Number of flooding events per year at The Battery for 1959-2007 after adding a specified sea level rise of 12.5 cm (white bars), 25 cm (gray bars) and 50 cm (black bars). From Colle et al. (2010).

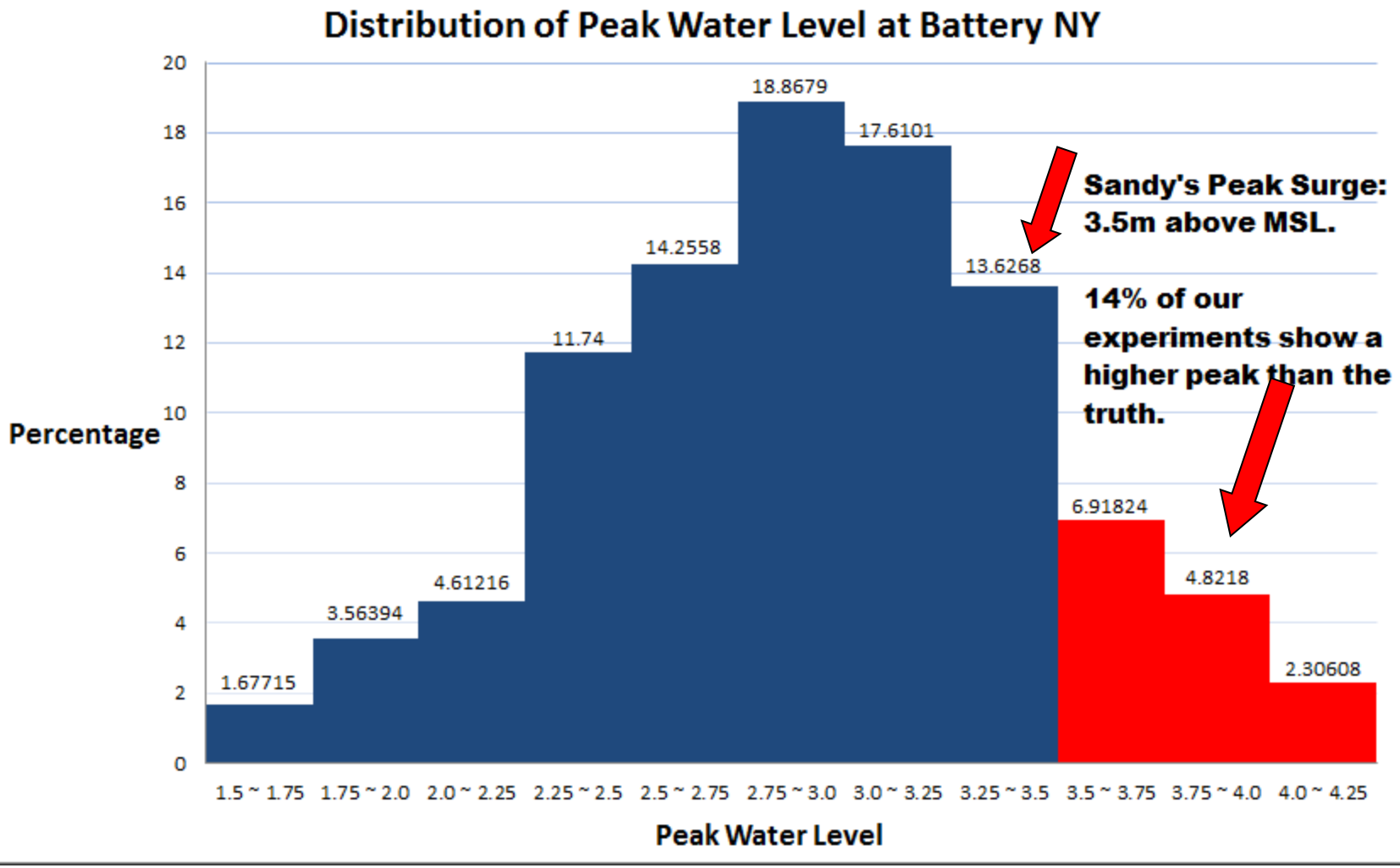


http://www.harborestuary.org/aboutestuary-climatechange-tides.htm

New York Harbor endures two surges; one propagating through Long Island Sound and the second entering through the Verrazano Narrows.



Effect of diurnal inequality at The Battery NYC. The Sandy water level peak tide was not the highest of the day.



Battery mean = 2.93 m, sigma = +/- 0.53 m,

In Wake of Sandy, NOAA Alters Hurricane Warning Policy

Published: April 4th, 2013 , Last Updated: April 4th, 2013

Share 122 Tweet 70 Share 37 Pinterest 0 +1 0

Print | Permalink | RSS |

By Andrew Freedman

Follow @afreedma 3,777 followers

Ahead of the 2013 Atlantic Hurricane Season and in the wake of Hurricane Sandy, the Natic
announced Thursday that it is changing its policy on the issuance of tropical storm and h
warnings. The changes will give forecasters more flexibility in issuing hurricane warn
authority for issuing such warnings.

Beginning on June 1, the agency will be permitted to leave watches and warr
ransitions into a post-tropical cyclone, which technically speaking is a d
pical origins, provided that the storm still poses "a significant thre

HURRICANE SANDY

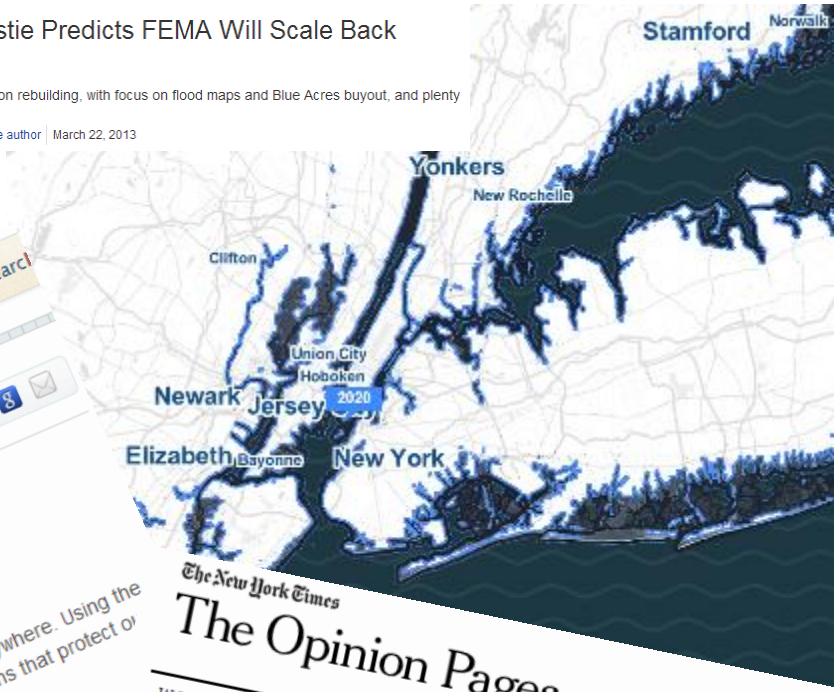
Government

UPDATE: Christie Predicts FEMA Will Scale Back Flood Maps

Governor provides update on rebuilding, with focus on flood maps and Blue Acres buyout, and plenty of anecdotes

By Catherine Galioto | Email the author | March 22, 2013

Maps Basics Researc



Surging Seas

Sea level rise analysis by CLIMATE CENTRAL

Rising Seas a Real Threat to New Jersey

By Ben Strauss & Robert Kopp

July 10, 2012

Note: First published in

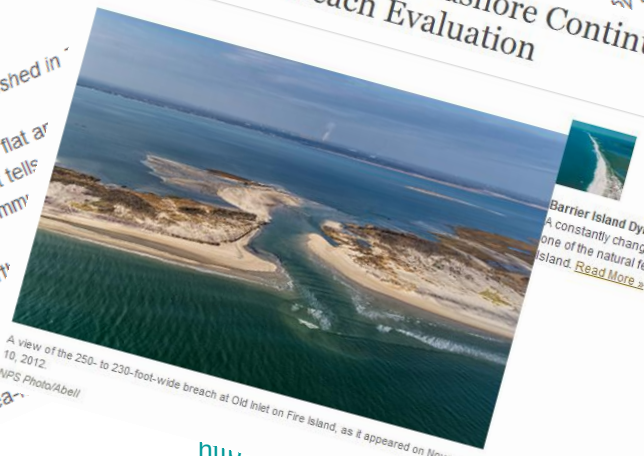
The sea isn't flat ar
science that tells
coastal comm

The nort
Meridi
Eur
sea

Fire Island National Seashore Continues Wilderness Breach Evaluation

se at the same rate everywhere. Using the
aking policy decisions that protect o

y the slowing of th
the Caribbe
Coas



A view of the 250- to 230-foot-wide breach at Old Inlet on Fire Island, as it appeared on November 10, 2012.
NPS Photo/Abell

Barrier Island Dynamics
A constantly changing shoreline is one of the natural features of Fire Island. Read More »

The New York Times

The Opinion Pages

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH

OP-ED COLUMNIST

A New Manhattan Project

By BILL KELLER

Published: November 11, 2012 | 263 Comments

n the monster storm struck, my colleagues at The Times's Room
ebate desk asked an array of experts whether New York should
d protective barriers against the next one. The answers covered,
ion the expression, the waterfront: Do something big! ("Worth
Investment") Do something small! ("Big Projects, Big Problems")
nothing much! ("Low on the List of Life-Saving Ideas") Think
ut doing, well, something! ("A Wake-Up Call to Consider the
tions")

http... /gauge/8518750#show=cities&cen
ter=10/40.7...

Sea-Level Rise

- More than 8 million people live in areas at risk of coastal flooding. Along the U.S. Atlantic Coast alone, almost 60 percent of the land that is within a meter of sea level is planned for further development, with inadequate information on the potential rates and amount of sea level rise.

- Range of rise varies on low end, 12 inches and high end, 6 feet over a 100-year period.

- USACE contributed to the Sea Level Rise Tool for Sandy Recovery to create a set of map services to help communities, residents, and other stakeholders consider risks from future sea level rise in planning for reconstruction following Hurricane Sandy.

16 Thursday, November 15, 2012 DAILY NEWS NYDailyNews.com

SANDY: PICKING UP THE PIECES

NEVER AGAIN!

Dutch model could stormproof city

BY JASON SHEFTELL
NEW YORK DAILY NEWS

HOW CAN we prevent this from happening again?

That's the question on the lips of those from New York's hardest-hit streets. City architects and officials have been trying to answer that question and consider ways to protect New York from another storm of Sandy's magnitude since her waters receded.

"Rather than looking to short-term housing solutions, consider long-term/permanent housing solutions to reduce the number of moves and disruptions to lives of families," says Michelle Whetten, VP & market leader, Gulf Coast, Enterprise Community Partners.

Stephen M. Sweeney, president of the New Jersey Senate, agrees. "We just can't rebuild it the way it was. The worst thing to do is to have this experience and not learn from it."

In addition to preparing for future storms with hurricane kits and home generators, we can look to nations like the Netherlands, which has experienced deadly floods for eight centuries, for innovative solutions.

Jackson Heights-based architect Haiko Cornelissen grew up below sea level in Amsterdam. He took note as his country employed flood-prevention measures in harbors, along the coastline and in various housing styles constructed specifically to survive water disasters.

Acting fast after Sandy, Cornelissen has set up the website NL4US.com, which offers safe and sustainable solutions for rebuilding in flood-prone areas in the United States.

Concepts including amphibious houses and anti-flood systems around bridges are described in detail. Speaking to engineers in his home country, the architect considered cost, time, building codes and location before landing his thoughts.

"We've experienced flooding in the Netherlands for centuries," says Cornelissen, whose Queens apartment was recently highlighted by the Guggenheim Museum in a tour of local homes. "The ideas are here for New York, but the themes also can help in New Orleans, Florida and the West Coast such as Seattle and San Francisco. This is a platform for solutions."

The estimated cost of some of the systems he suggests for protecting the harbor are upward of $6 billion per feature, but that figure could be a fraction of future damages.

"The total cost of the storm could be as high as $30 billion. To secure New York Harbor and certain waterways could cost $18 billion or so," says Cornelissen, who has worked for top global architects Rem Koolhaas and Steven Holl.

Here's how some of those Dutch innovations would look around Manhattan with explanations on how each would work in a future flood.

1. Amphibious Houses

"This type of house looks and acts like any other typical house, except in times of flooding, says Cornelissen. "When the area floods, the amphibious house floats on the water, held in place by guides, and continues to function thanks to the flexible utilities. The amphibious house is more a new type of construction than a new type of house."

Add solar energy, says Cornelissen, and the amphibious house can operate off the grid, or on its own even in power outages.

Haiko Cornelissen

2.Floating Houses in Battery Park

According to Cornelissen, the "floating communities in Amsterdam activate the waterfront with prime location apartments that have the most amazing views in the city while they remain safe from flooding." Here, they placed the floating houses built in Amsterdam near Battery Park to demonstrate how the concept might work locally.

3. Verrazano-Narrows Bridge and New York City Harbor flood prevention

Experts and politicians including Gov. Cuomo recently agreed that bold steps are needed to protect the city from flooding in the future.

The Dutch government took a bold step in the 1950s to preserve the Netherlands' southern end with an unprecedented flood protecting infrastructure called Delta Works.

Based on the Dutch example, the Storm Surge Research Group at Stony Brook recommended in 2004 to use a similar solution with movable barriers around the New York Harbor, including under the Verrazano-Narrows Bridge.

"Thinking along these lines, I combined the Verrazano with the Maeslantkering, a barrier that protects Rotterdam, the busiest harbor of Europe," Cornelissen says. "The Maeslantkering completed the Delta Works after four decades of building the complete flood-protection infrastructure. The area has not flooded since.

"While the Bloomberg administration has aggressively promoted waterfront development in the city, the New York waterfronts are now the areas hit hardest by the recent storms," says the architect.

"Therefore one alternative to promote waterfront development is to use floating houses as seen in new parts of Amsterdam."

jsheftell@nydailynews.com

For more info, go to NL4US.com or haikocornelissen.com.

Governor Cuomo states the need for a new paradigm – let's stop arguing about climate change and let's move ahead and develop bold new approaches…

http://www.pressdisplay.com/pressdisplay/viewer.aspx

http://www.governor.ny.gov/press/01092013-cuomo-agenda-2013

Related Media

Andrew M. Cuomo - *Governor*

Printer-friendly version

Governor Cuomo Outlines Bold Agenda for 2013: Builds on Progress of Past Two Years by Growing the Economy, Investing in Education, Maintaining Legacy as Progressive Capital of the Nation, and Rising to Meet Challenges in the Wake of Hurricane Sandy

- **Toward a More Resilient New York Harbor:** To build a more resilient Harbor, a long-term strategy will need to be developed that includes conserving and rebuilding natural systems that were lost to centuries of man-made activity, plus the building of additional barriers where needed. The state will work with other government partners to timely complete a comprehensive engineering evaluation of proposals, including potential barrier systems.
- **Harden the Subway System:** Flood-proof subways and bus depots with vertical roll-down doors, vent closures, inflatable bladders, and upsized fixed pumps (with back-up power sources) are all options to harden New York's subway system.
- **Harden our Fuel Delivery System:** Redundancies must be built into the fuel system, and generators and pumping systems must be readily deployable. The Governor proposed that gas stations in strategic locations be required to have on-site back-up power capacity to protect New Yorkers from temporary disruptions in fuel supply.
- **Harden our Utilities:** The Public Service Commission will require utilities to submit detailed implementation plans to harden their facilities, including raising substation walls and elevating transformer inst allations.
- **Strengthen Wastewater Infrastructure:** Flooding and storm surges from Lee, Irene, and Sandy resulted in hundreds of millions of dollars of damage to waste water treatment plants and the release of hundreds of millions of gallons of raw and undertreated sewage. To prevent a repeat of this scenario in the short-term, the existing wastewater treatment plants need to be repaired and mitigated to withstand higher flood levels.

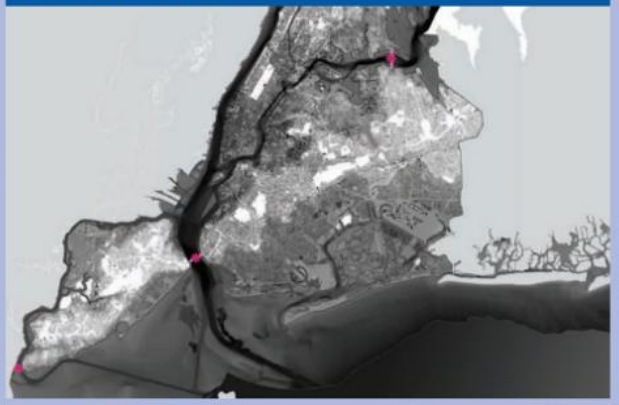
Harborwide Storm Surge Barriers

A variety of observers have raised the idea of harborwide storm surge barriers in response to the threat of coastal storms faced by New York City. One proposal that has been put forth, for example, calls for a three-part design, consisting of closure gates at the Narrows, the Arthur Kill, and the upper reaches of the East River. A second proposal would require two barriers, one at the upper reaches of the East River and one connecting Sandy Hook, NJ with the Rockaway Peninsula. In each case, the closure gates would be navigable channel openings, allowing ship traffic and water to flow through under ordinary circumstances. During storm events, however, the gates would be closed, in theory, blocking surge waters. To make either of these proposals work, a series of levees extending out from the closure gates would need to be constructed to ensure that displaced water is not simply pushed into low-lying areas adjacent to the closure gates. (*See map: Alternative 1: Three Barriers; See map: Alternative 2: Two Barriers*)

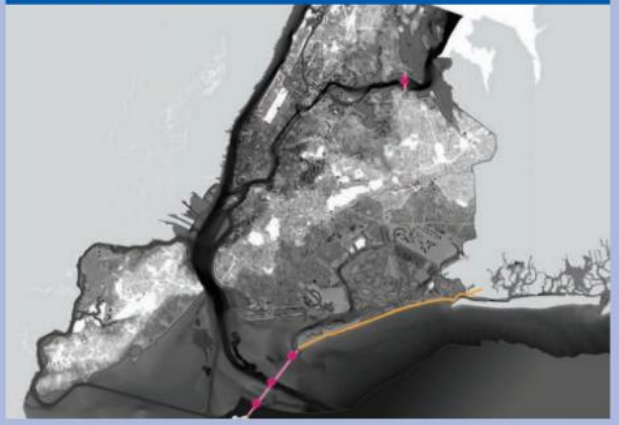
For some observers, the idea of constructing a single piece of engineering offers the appeal of seeming simplicity, as compared to a suite of a more targeted, localized protections. However, the construction of such harborwide storm surge barriers actually presents many complications:

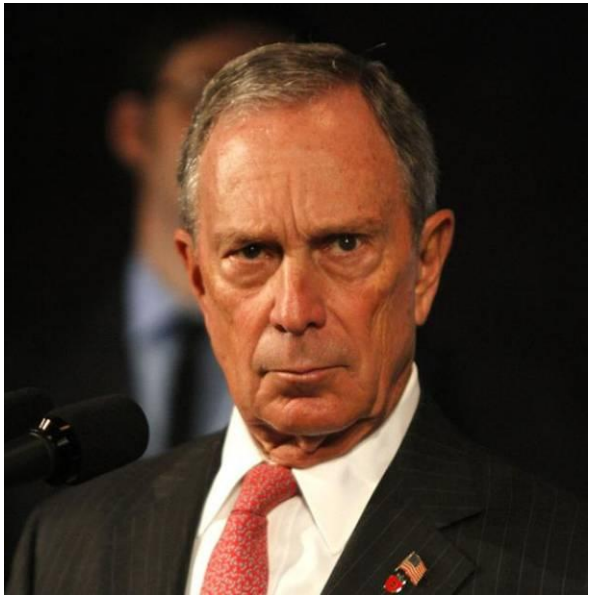
- First, such a system of barriers would be extraordinarily expensive—perhaps costing $20 to $25 billion to build, with substantial operating and maintenance costs—substantially more than the City's proposed Phase 1 coastal protection initiatives and substantially more than any source of funding currently identified.
- Second, harborwide barriers would require a design, approval, and construction process that could, based on past experience with major in-water engineering projects in the New York City area and elsewhere around the globe, take two to three decades to complete.
- Third, the possible hydrodynamic and environmental impacts (on fish migration, siltation, river flow, and water quality) of harborwide barriers are likely to be substantial, are not yet known, and would require extensive study, potentially derailing or requiring substantial redesign of the project. These impacts also could be the subject of lawsuits—which have, in New York's relatively recent past, led to the cancellation of major in-water projects.
- Fourth, as mentioned above, to make a project such as this work, there likely would need to be massive levees (20 feet or more above grade) along adjacent coastal areas, including on the Rockaway Peninsula and possibly Coney Island and Staten Island, depending on which barrier option is chosen. These levees would have dramatic impacts on the character of the beaches and adjacent neighborhoods that may prove to be highly disruptive.
- Fifth, any barriers would create an "insiders/outsiders" dynamic, with only those behind the barriers receiving maximum protection, leaving densely developed communities along the South and North Shores of Long Island and the Jersey Shore outside the protected zone.
- Sixth, a harborwide barrier project may also cause additional flooding in areas outside the barriers (especially in tighter waterways, such as the Upper East River), thus making those communities more vulnerable than they would be without such barriers.
- Seventh, and finally, since the barriers would be open most of the time (to allow navigation), it would represent a major public investment that would end up doing nothing to address the growing problem of rising sea levels.

Alternative 1: Three Barriers



Alternative 2: Two Barriers



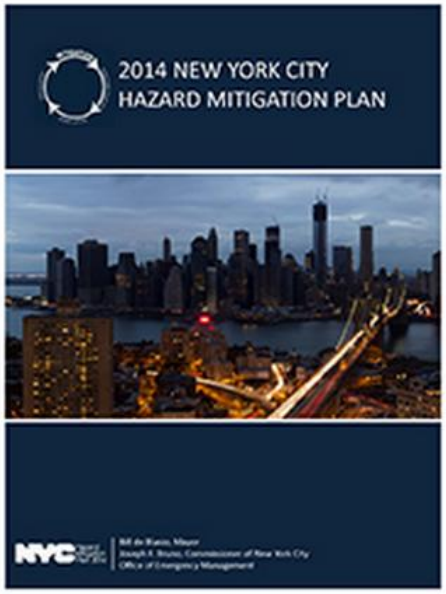


That Bowman guy out at Stony Brook is full of &*#$@ with his crazy ideas about huge storm surge barriers….

http://www.nyc.gov/html/planyc/html/home/home.shtml

← The seven deadly sins.

Emergency Planning: Hazard Mitigation Plan



Now let's upgrade to mitigation from mere resilience!

Presenting the Final 2014 New York City Hazard Mitigation Plan

The New York City Office of Emergency Management (OEM), in partnership with the Department of City Planning (DCP), is pleased to announce the official adoption of the 2014 New York City Hazard Mitigation Plan (HMP). The preparation of the HMP demonstrates New York City's continued commitment to understanding our risk from a range of hazards, and identifying strategies to reduce the effects of these hazards on New York City's environment. The 2014 HMP serves as an update to the 2009 New York City Natural Hazard Mitigation Plan.

The HMP was approved by New York State Division of Homeland Security and Emergency Services (NYS DHSES) and FEMA on March 21, 2014, and officially adopted by the City of New York on April 15, 2014.

http://www.nytimes.com/2012/11/04/nyregion/protecting-new-york-city-before-next-time.html?pagewanted=all

Science fiction…….

http://www.pbs.org/wgbh/nova/tech/storm-surges-cities.html

Bring back the oysters beds of the 1800's!

http://www.pbs.org/wgbh/nova/tech/storm-surges-cities.html

Poaching proliferates! Would you eat those oysters from such polluted waters? Not me!

The New York Times

MAGAZINE

121 COMMENTS

How to Think Like the Dutch in a Post-Sandy World

By RUSSELL SHORTO APRIL 9, 2014

EMAIL
FACEBOOK
TWITTER
SAVE
MORE

In December 2012, Shaun Donovan, the secretary of Housing and Urban Development, was on vacation in Berlin when he decided to detour to the Netherlands. He wanted to get a firsthand sense of the famed Dutch approach to water management. Hurricane Sandy struck six weeks before, and in the aftermath, President Obama asked him to lead a task force, whose objective was not just to rebuild but also to radically rethink the region's infrastructure in light of climate change.

In the Netherlands, a man named Henk Ovink offered to be Donovan's guide. Ovink was the director of the office of Spatial Planning and Water Management, meaning, essentially, that it was his job to keep the famously waterlogged country dry. As he learned about various Dutch innovations, Donovan was struck by the fact that Ovink looked at water as much in cultural as in engineering terms, which was a function of the centuries-old need of the Dutch to act together for protection.

For his part, Ovink said it dawned on him during Donovan's visit that the post-Sandy turmoil in the U.S. was an opportunity. Dutch water-management experts have done such a good job of protecting their country that they rarely get to practice with water crises — whereas America was facing something monumental that as a culture it didn't yet grasp. When Donovan arrived back in the U.S., he opened an email from Ovink that said, in effect, "I hope this isn't too forward, but could I come work with you?"

Henk Ovink, a Dutch water-management expert, is trying to persuade Americans to approach water the way the Dutch do. Olivia Locher for The New York Times

Henk Ovink

Now this guy's all wet.

Winning Proposal

REBUILD BY DESIGN

An Initiative of the President's Hurricane Sandy Rebuilding Task Force

In Collaboration With
NYU's Institute for Public Knowledge
Municipal Art Society
Regional Plan Association
Van Alen Institute

Lead Supporter
The Rockefeller Foundation

With Support From
Deutsche Bank Americas Foundation
Hearst Foundation
Surdna Foundation
The JPB Foundation
The New Jersey Recovery Fund

LIVING BREAKWATERS

SCAPE / Landscape Architecture
Staten Island, New York

Hunts Point Lifelines

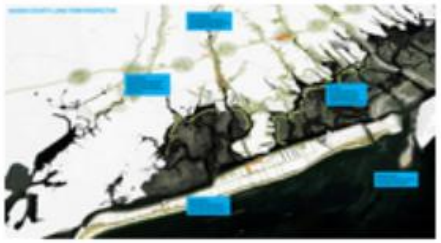
PennDesign/OLIN
Bronx, New York

Resist, Delay, Store, Discharge: A Comprehensive Strategy for Hoboken

OMA
Hoboken, New Jersey

New Meadowlands: Productive City + Regional Park

MIT CAU + ZUS + URBANISTEN
The Meadowlands, New Jersey



Living with the Bay: A Comprehensive Regional Resiliency Plan for Nassau County's South Shore

Interboro Team
Long Island, New York

BIG U

BIG TEAM
New York, New York

Rebuild by Design Redesigns Sandy-Battered Shore

Scape's team proposes a necklace of breakwaters along the South Shore of Staten Island to buffer against wave damage, flooding, and erosion. A "reef street" would host finfish, shellfish, and lobsters. The team also modeled the breakwater system at a macro scale to understand how and where they could most effectively protect communities.

Image courtesy Rebuild by Design

View Related Story »

Rebuild by Design Redesigns Sandy-Battered Shore

WXY Architecture and Urban Design and West 8 avoided high flood walls by proposing a series of protective sand islands that would run along the Atlantic seacoast from Cape Cod, Massachusetts, to Cape May, New Jersey.

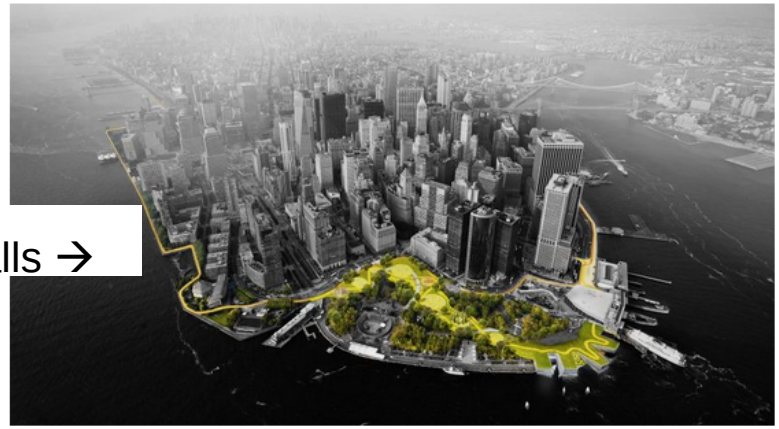
Image courtesy Rebuild by Design

View Related Story »

IABR–2014–
URBAN BY NATURE–

◂URBAN BY NATURE / THE EXHIBITION /

URBAN LANDSCAPE AND CLIMATE CHANGE



IABR–2014–PROJECT #32D: REBUILD BY DESIGN - BIG U
© BIG Team

In **URBAN LANDSCAPE AND CLIMATE CHANGE** the results of the competition **Rebuild by Design** that responds to Hurricane Sandy, will take prominent place.

Superstorm Sandy
On October 29 2012, after a ravaging ride that started in the Caribbean and would eventually cause the death of at least 286 people in seven different countries, Superstorm Sandy slammed into New Jersey and New York with unprecedented force. The chaos that followed was just as unprecedented. The world's most important metro region remained completely dysfunctional for days. 8.5 million people were without electricity, 650,000 houses and over 100,000 companies were damaged or destroyed. Estimates as of June 2013 assess the damage at over 68 billion US dollars.

Lego walls →

◂URBAN BY NATURE / THE EXHIBITION /
URBAN LANDSCAPE AND CLIMATE CHANGE /

RESILIENCE

ALEXANDROS WASHBURN, CRUX

"Resilience has to be achieved not at the cost of a community but by making a community better" says Alexandros Washburn, founder of CRUX, The Center for Coastal Resilience and Urban Xcellence at the Stevens Institute of Technology, in the film 'Resilience'. [...]

READ MORE

Fig. 1 "Lego Wall planned for NYC business district".

Physical Resiliency

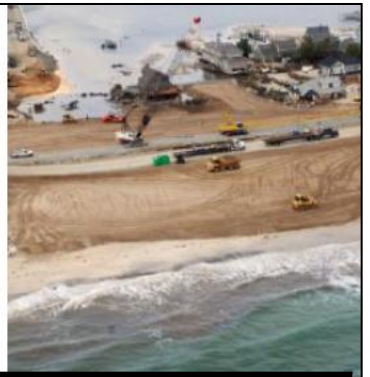
New infrastructure can help reduce the risk to our neighborhoods, critical services, businesses, and vulnerable populations.

Integrated Flood Protection Systems

Risk Reduction Structural Solution Sets







Levees	Storm Surge Barriers	Seawalls and Revetments	Groins	Detached Breakwaters
Benefits/Processes •Surge and wave attenuation and/or dissipation •Reduced flooding •Reduced risk for vulnerable areas	**Benefits/Processes** •Surge and wave attenuation •Reduced salinity Intrusion	**Benefits/Processes** •Reduced flooding •Reduced wave overtopping •Shoreline stabilization behind structure	**Benefits/Processes** •Shoreline stabilization	**Benefits/Processes** •Shoreline stabilization behind structure •Wave attenuation
Performance Factors •Levee height, crest width, and slope •Wave height and period •Water level	**Performance Factors** •Barrier height •Wave height •Wave period •Water level	**Performance Factors** •Wave height •Wave period •Water level •Scour protection	**Performance Factors** •Groin length, height, orientation, permeability, and spacing •Depth at seaward end •Wave height •Water level •Longshore transportation rates and distribution	**Performance Factors** •Breakwater height and width •Breakwater permeability, proximity to shoreline, orientation, and spacing

Risk Reduction Nature-Based Solution Sets

				
Dunes and Beaches	**Vegetated Features**	**Oyster and Coral Reefs**	**Barrier Islands**	**Maritime Forests/Shrub Communities**
Benefits/Processes •Breaking of offshore waves •Attenuation of wave energy •Slow inland water transfer	**Benefits/Processes** •Breaking of offshore waves •Attenuation of wave energy •Slow inland water transfer •Increased infiltration	**Benefits/Processes** •Breaking of offshore waves •Attenuation of wave energy •Slow inland water transfer	**Benefits/Processes** •Wave attenuation and/or dissipation •Sediment stabilization	**Benefits/Processes** •Wave attenuation and/or dissipation •Shoreline erosion stabilization •Soil retention
Performance Factors •Berm height and width •Beach slope •Sediment grain size and supply •Dune height, crest, and width •Presence of vegetation	**Performance Factors** •Marsh, wetland, or SAV elevation and continuity •Vegetation type and density	**Performance Factors** •Reef width, elevation, and roughness	**Performance Factors** •Island elevation, length, and width •Land cover •Breach susceptibility •Proximity to mainland shore	**Performance Factors** •Vegetation height and density •Forest dimension •Sediment composition •Platform elevation

Locator map of the village of Monster on the south west coast of the Netherlands, where beach dune enhancements are the current mode of coastal protection.

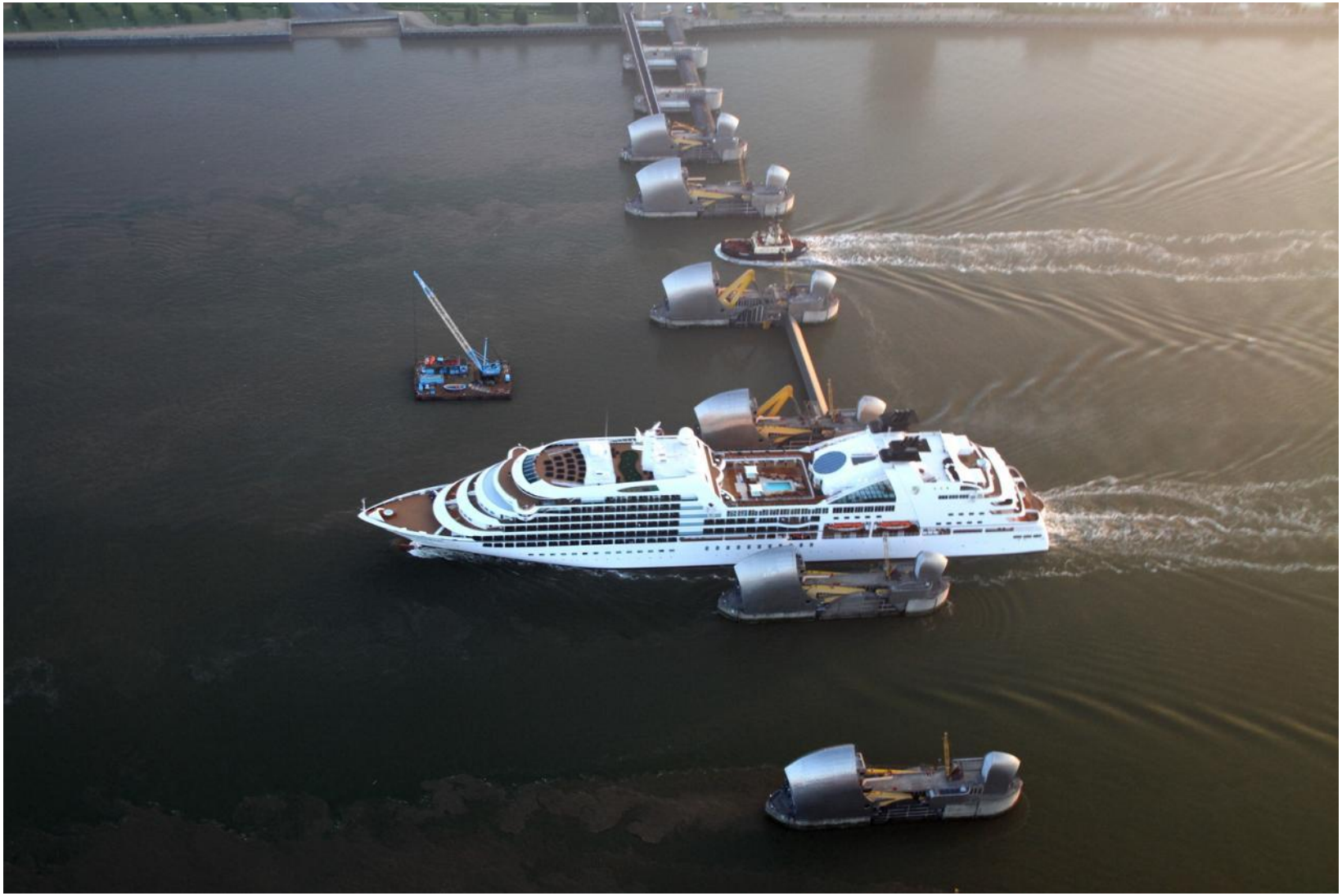
Swinging the camera to the right shows the seaside village of Strand Monster safely tucked in behind the high dunes. The downside is that the view of the ocean is lost. So the residents have traded the view for security.

Josh Robin of News 1 NY interviews Prof. Jeroen Aerts of the University of Amsterdam who explains how enhanced beach dunes protect the tourist community of Noordwijk, The Netherlands.

Tourist hotels are located well back, behind the dunes, but still enjoy a good view.

View of a segment of the Delta Project, the Netherlands. The system is composed of a mixure of elevated natural sand dunes, tidal gates (normally open), elevated highways and shipping gates <http://www.deltawerken.com/English/10.html?setlanguage=en>. The image is taken during flooding (incoming) tides.

Fig. 2: Dutch storm surge barrier at Maeslant



The Thames River Barrier was opend in 1982 and has been used many times to prevent the City of London from flooding.

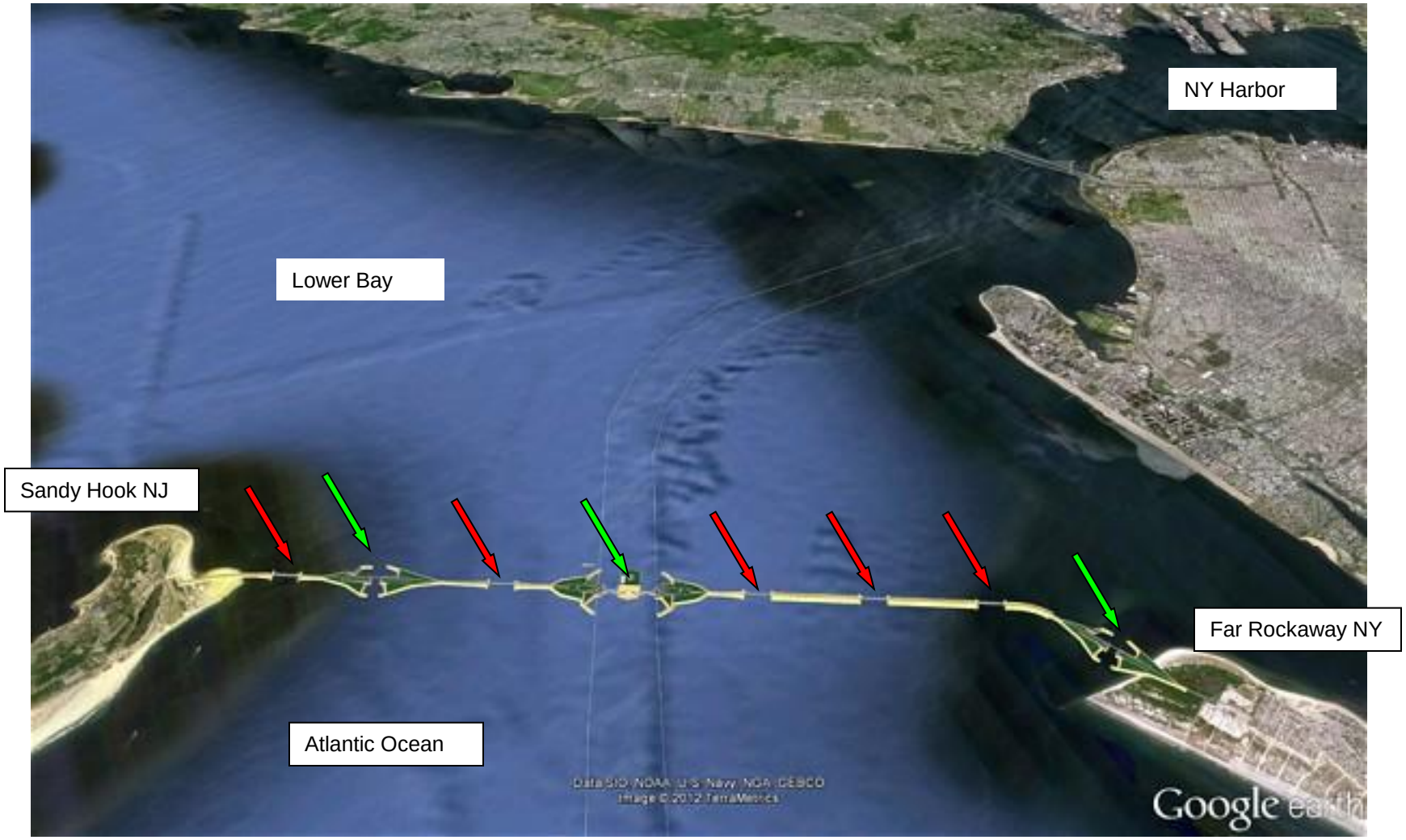
Plan view of St Petersburg, Russia, storm surge protection system, consisting of elevated multi-lane highways (blue), harbor barriers with sluice gates (blue) and shipping gates (red arrow).


(c) Ivanov Nikolay
www.airfotovideo.ru/users/Piloterr

Taintor gates in open position at the St Petersburg storm barrier system.

Taintor gates in closed position at the St Petersburg storm barrier system.

Schematic diagram for location of the Outer Harbor Gateway (red arrow) with enhanced extension dunes (green) and storm surge barriers (red line) to protect NY City. A second barrier would be necessary across the upper East River (red arrow) to block surges from penetrating from western Long Island Sound into the Harbor. Note the outer gateway (with extension) protects Manhattan, JFK airport, the outer boroughs of Staten Island, Brooklyn & Queens, Port Elizabeth, Newark Airport, LaGuardia Airport and all points within the ring of protection.



Artist's impression of the proposed New York Outer Harbor Gateway, stretching 5 miles across the Sandy Hook – Far Rockaway transect. The red arrows show locations of sluice gates to allow free flow of the tides (next slide). The green arrows point to the three shipping gates (second slide on).

Developing a Threat Index

Take our cue from the Europeans. Decide that the wreckage of Sandy must never happen again. Determine to protect Metro New York against a 1/1,000 storm. Make this the gold standard. Plug in various suggestions solutions and migitations appropriate to a descending scale of threats.

Threat	Response
1/1000 yr storm	Storm surge barriers, enhanced sand berms
1/500 year storm	Storm surge barriers, enhance sand berms
1/250 year storm	New building codes, raise all critical systems
1/100 year storm	Build better resilience, retire old building codes
1/25, 1/50 year storms	Enhance wetlands, oyster beds, local barriers

So if the Russians, the Italians, the Dutch, the Brits, the New Englanders and the Louisianans can do it right, why can't we New Yorkers show our mettle?

Thank you!