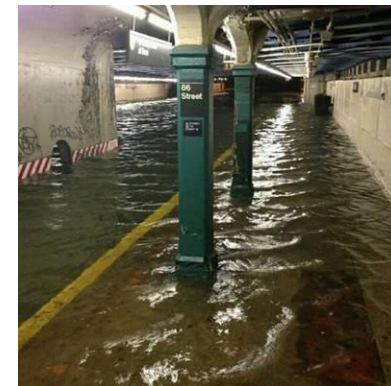


# “Storm Surge from Super-Storm Sandy: Causes and Impacts”

Malcolm J. Bowman

School of Marine & Atmospheric Sciences, Stony Brook Southampton

Friday 16 November 2012



## **RESEARCH TEAM:**

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The Eppley Foundation  
for Research, Inc.

# Bowman Malcolm

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From Wikipedia, the free encyclopedia

**Bowman Malcom** (1854–1933) was an Irish railway engineer. He became Locomotive Superintendent of the Belfast and Northern Counties Railway (BNCR) at the age of 22 and later took on the additional role of Civil Engineer. He was an advocate of compound locomotives which he introduced to the BNCR.

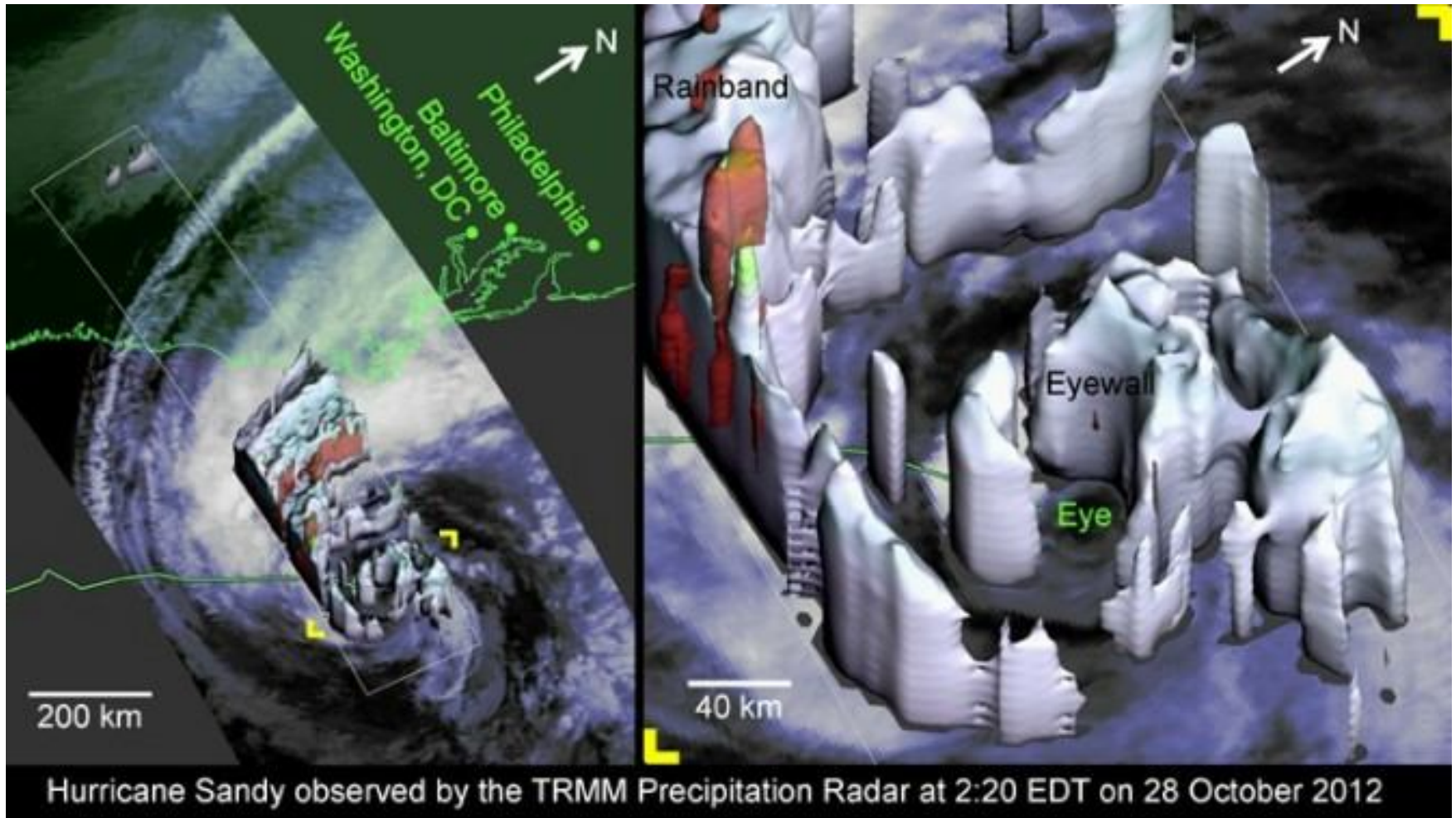
## Images of Destruction

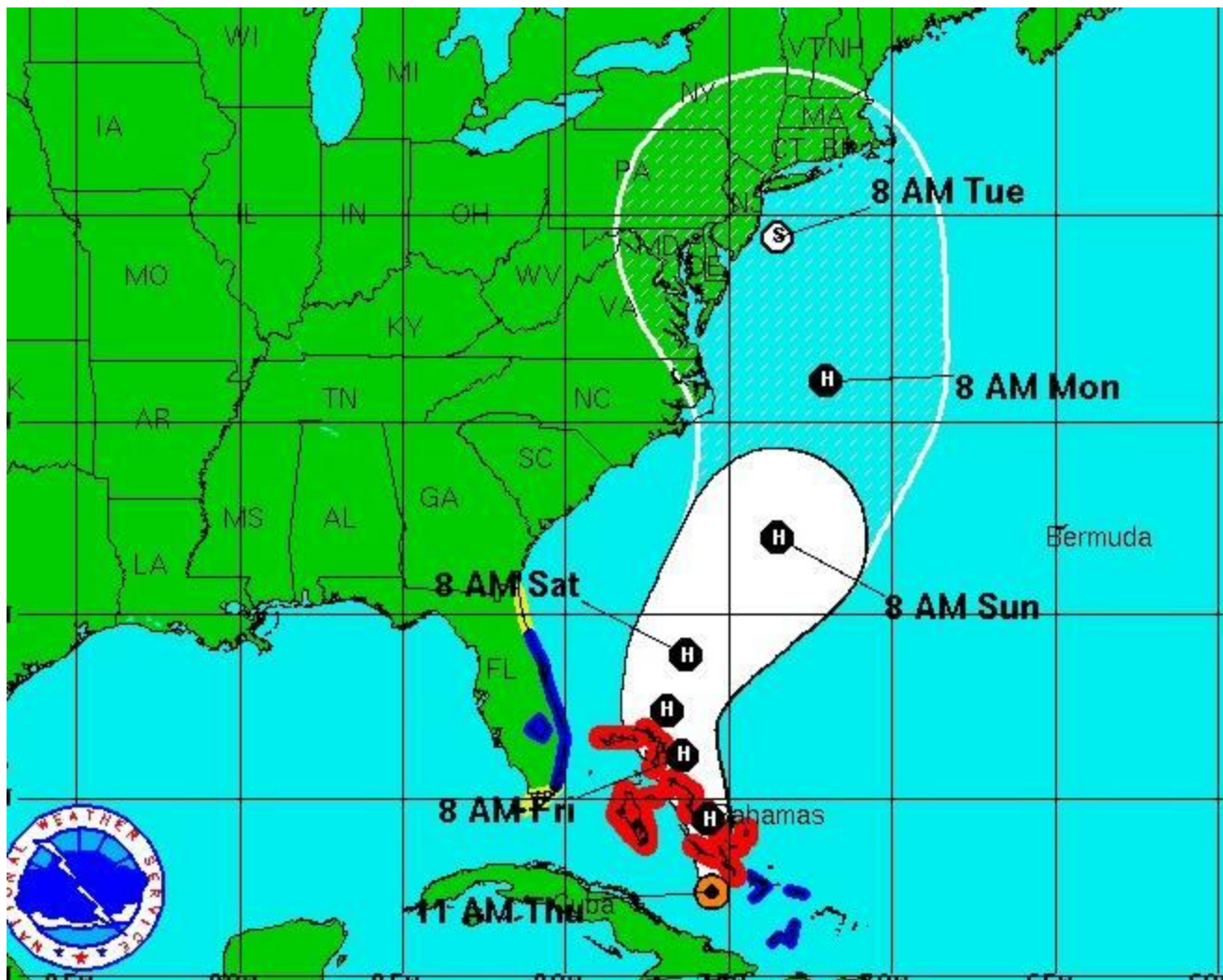
<http://latino.foxnews.com/latino/news/slideshow/2012/10/30/photos-hurricane-sandy-floods-new-york-city/?intcmp=related#slide=36>

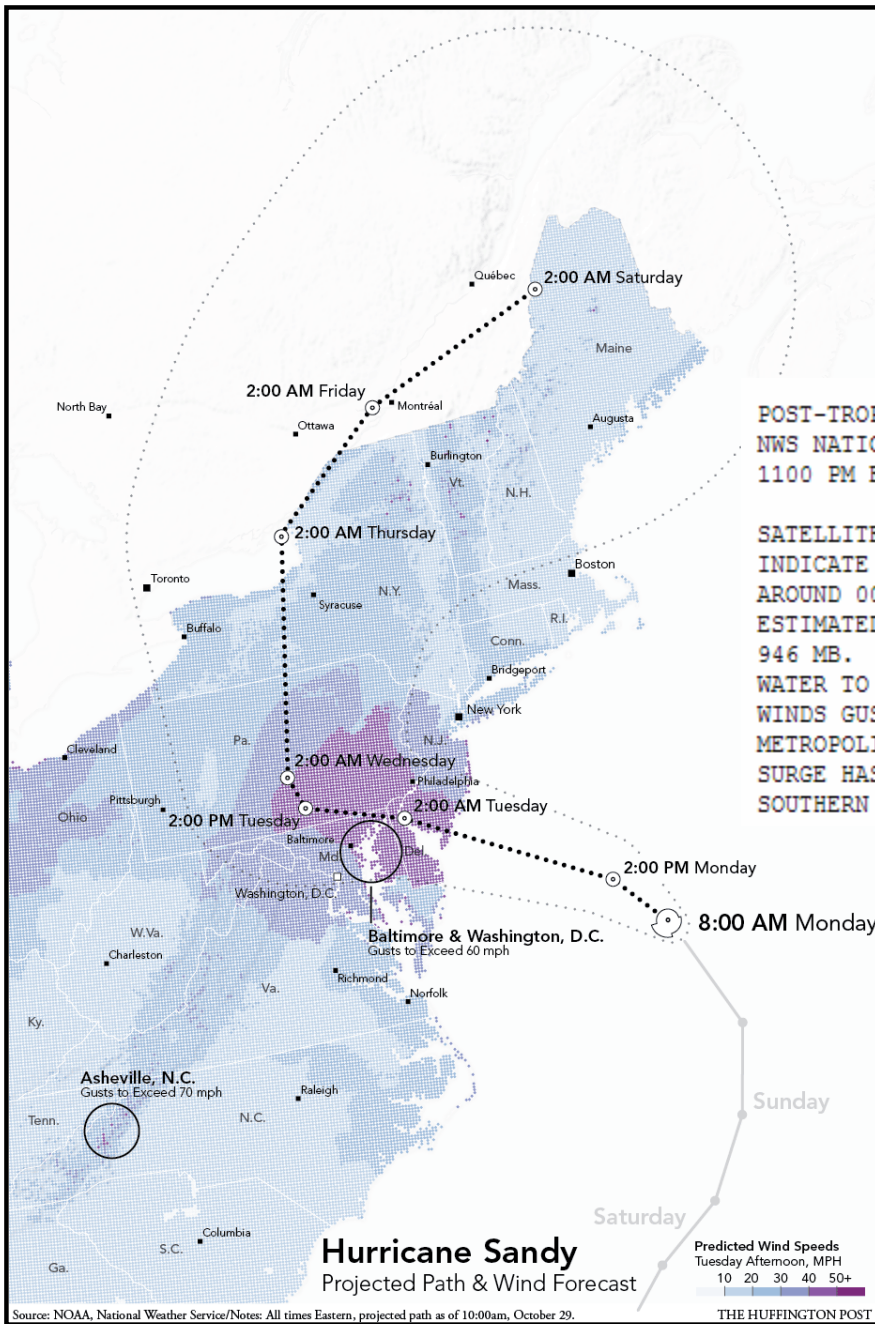




Visible satellite image of Hurricane Sandy 29 October 2012





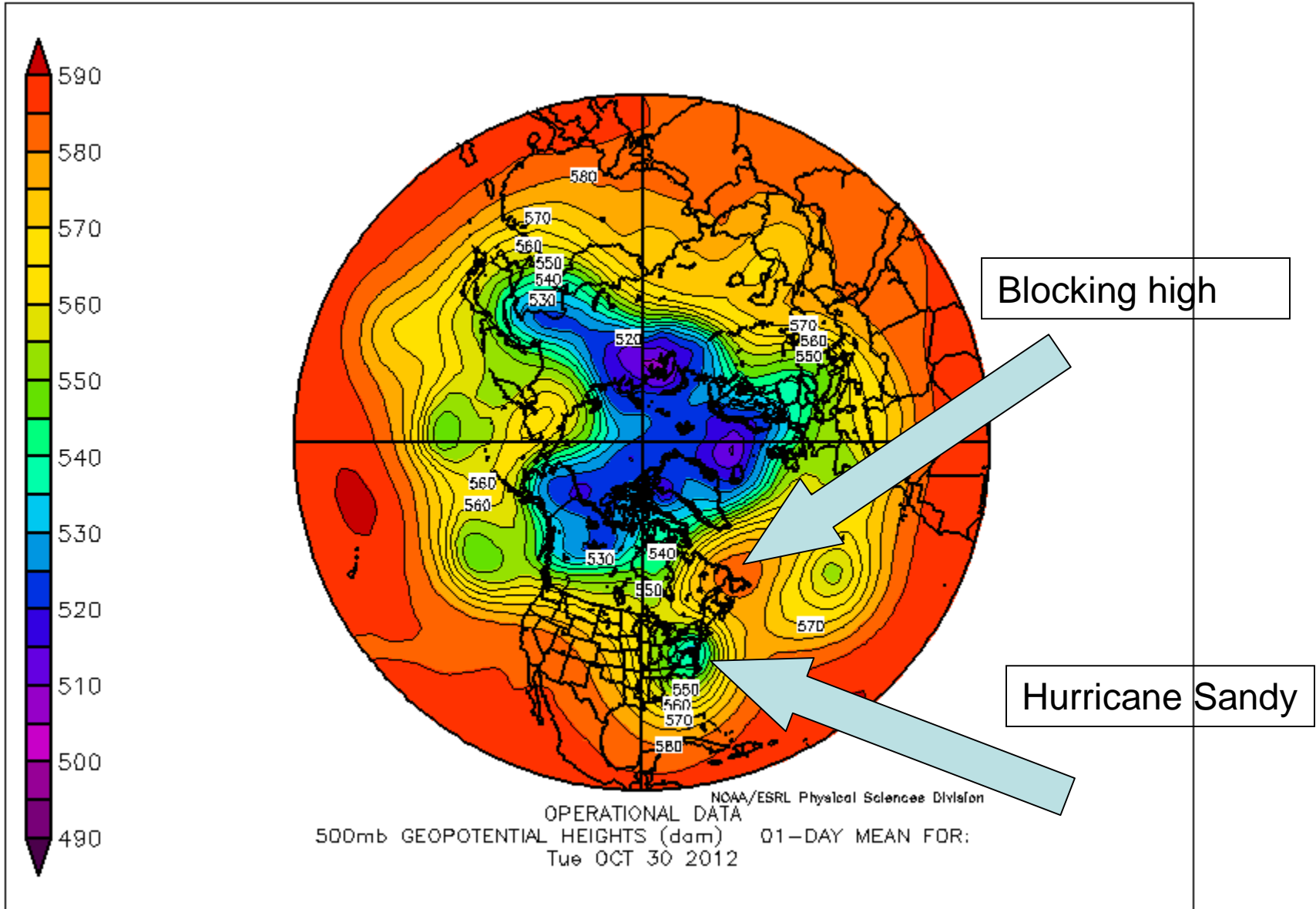


POST-TROPICAL CYCLONE SANDY DISCUSSION NUMBER 31  
 NWS NATIONAL HURRICANE CENTER MIAMI FL AL182012  
 1100 PM EDT MON OCT 29 2012

SATELLITE...RADAR...SURFACE...AND RECONNAISSANCE AIRCRAFT DATA INDICATE THAT SANDY MADE LANDFALL NEAR ATLANTIC CITY NEW JERSEY AROUND 0000 UTC. THE INTENSITY OF THE POST-TROPICAL CYCLONE WAS ESTIMATED TO BE NEAR 80 KT AT LANDFALL WITH A MINIMUM PRESSURE OF 946 MB. AT LANDFALL...THE STRONGEST WINDS WERE OCCURRING OVER WATER TO THE EAST AND SOUTHEAST OF THE CENTER. HURRICANE-FORCE WINDS GUSTS HAVE BEEN REPORTED ACROSS LONG ISLAND AND THE NEW YORK METROPOLITAN AREA THIS EVENING. IN ADDITION...A SIGNIFICANT STORM SURGE HAS OCCURRED ALONG A LONG STRETCH OF THE MID-ATLANTIC AND SOUTHERN NEW ENGLAND COAST.

[http://www.huffingtonpost.com/2012/10/29/hurricane-sandy-graphics\\_n\\_2038056.html](http://www.huffingtonpost.com/2012/10/29/hurricane-sandy-graphics_n_2038056.html)



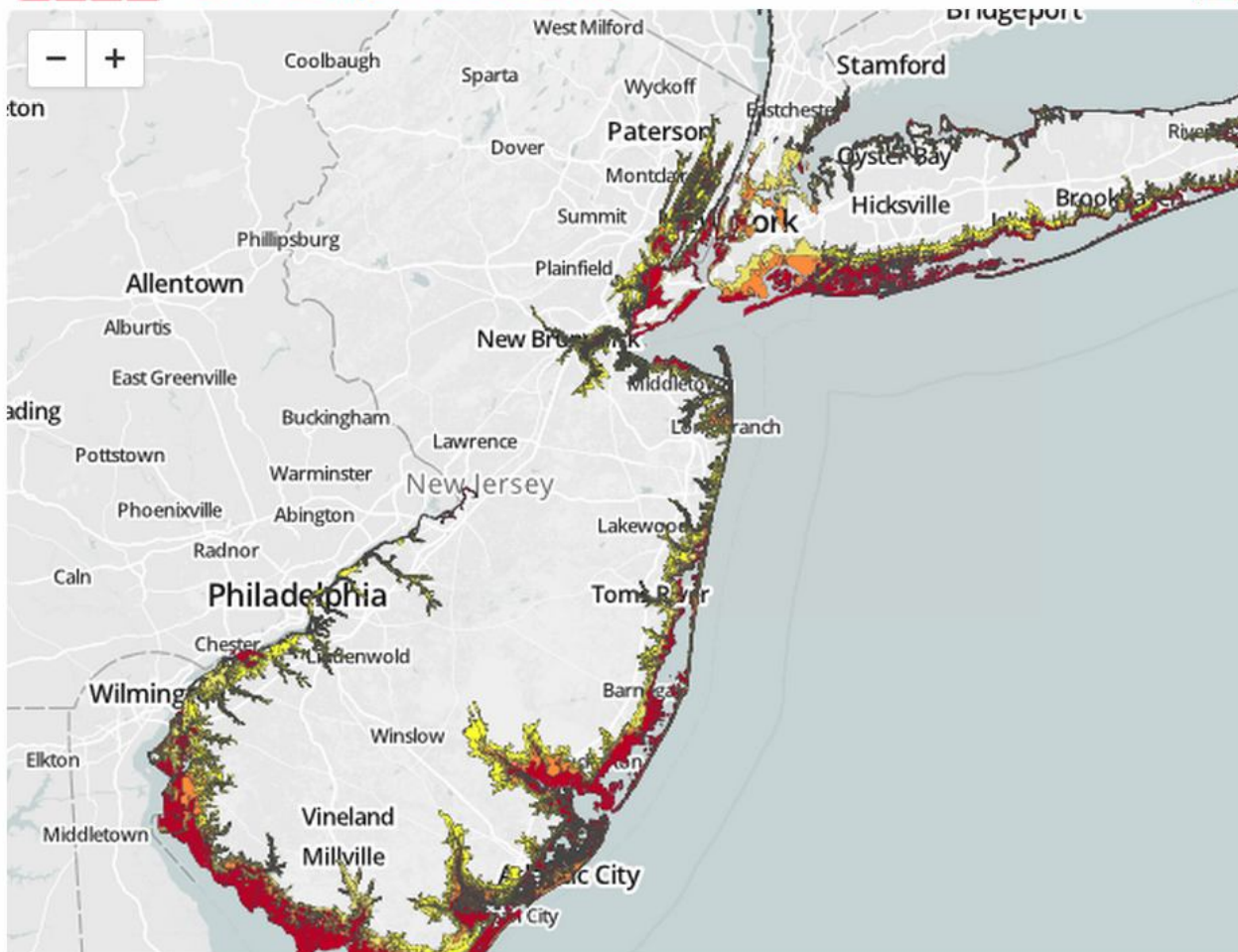




Fake Picture – there is no channel 1 TV.



“Welcome to Rockaway Beach!”



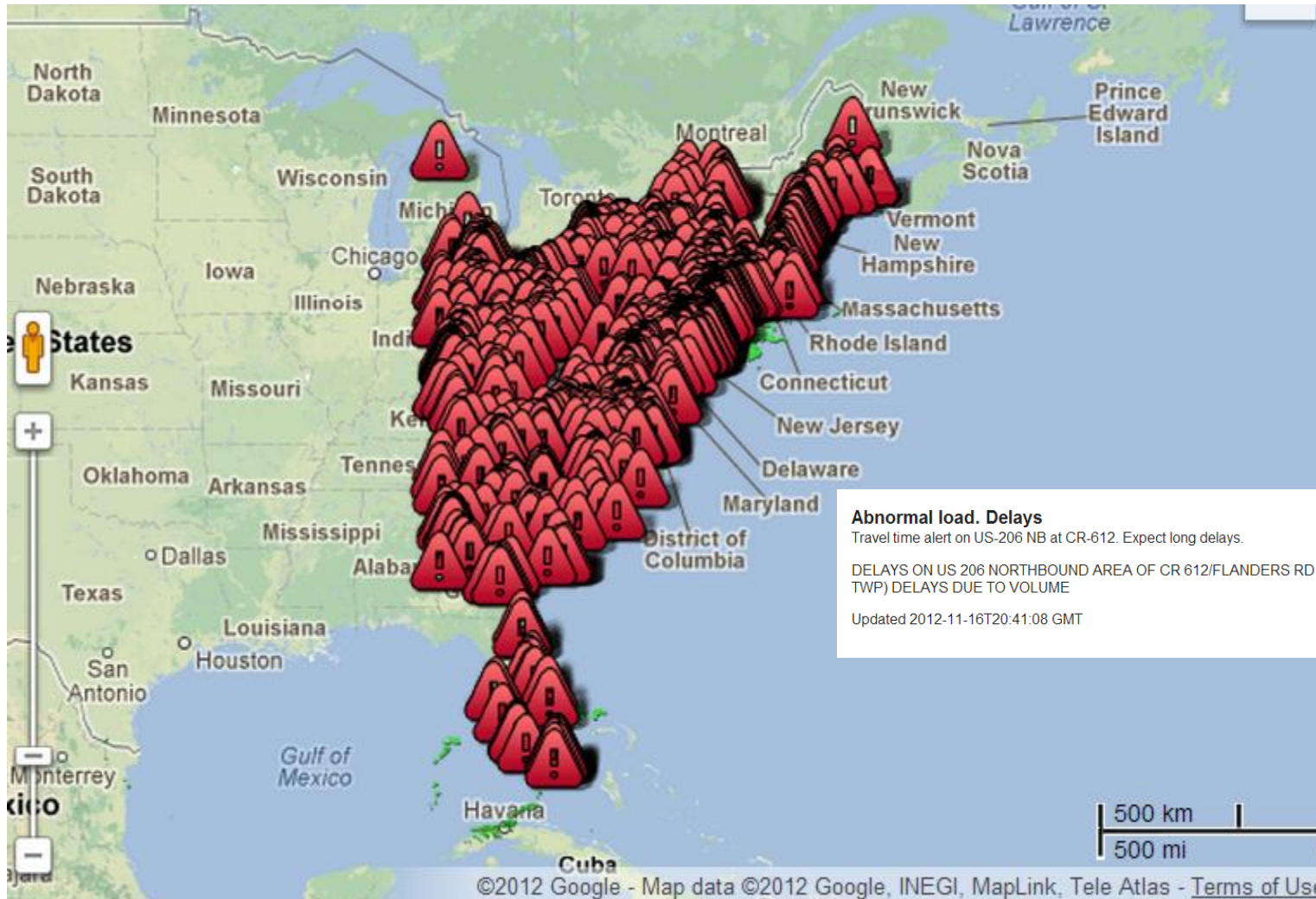
Potential storm-surge flooding by hurricane size:



Cat. 1 Cat. 2 Cat. 3 Cat. 4

*Actual flooding may vary due to storm variables or data errors. Flooding from rain not included. Heed official advisories, not this map, for life and property decisions.*

[http://www.cbsnews.com/8301-201\\_162-57541786/hurricane-sandy-storm-tracker-and-forecast-maps/](http://www.cbsnews.com/8301-201_162-57541786/hurricane-sandy-storm-tracker-and-forecast-maps/)



# Crisis Response Map

[http://www.cbsnews.com/8301-201\\_162-57541786/hurricane-sandy-storm-tracker-and-forecast-maps/](http://www.cbsnews.com/8301-201_162-57541786/hurricane-sandy-storm-tracker-and-forecast-maps/)

This map details hurricane evacuation routes, emergency shelter locations, and public alerts.



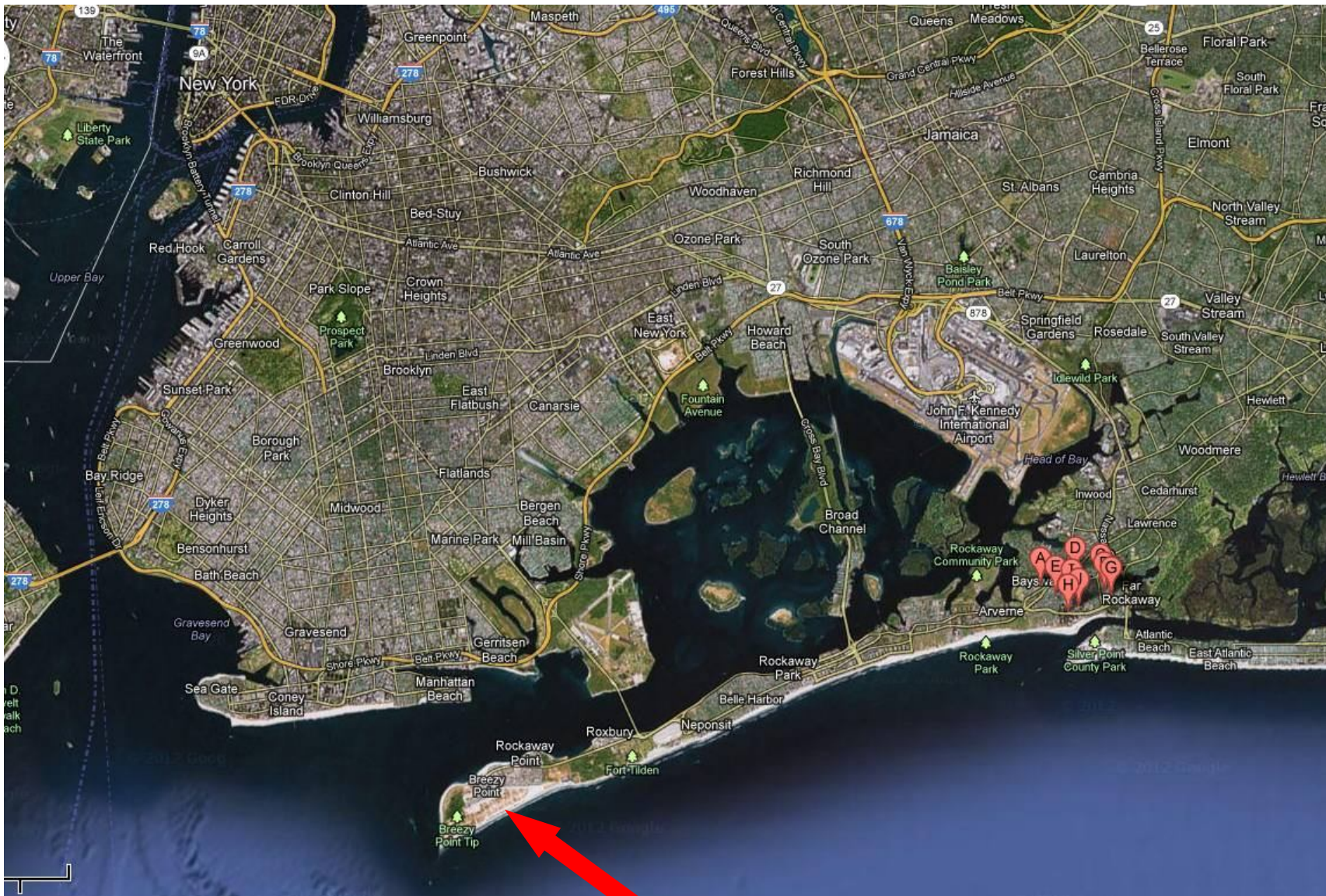


Flax Pond and Old Field Point









Breezy Pt community



Breezy Pt Community – Far Rockaways, Sunday 11 Nov 2012.

















Dear Breezy Point,  
I'm Isabel Layola from Denver Colorado.  
I'm in fourth grade and Ellen Mathis  
is my teacher she is a great teacher. I hope  
you are all okay! I pretty sure there are 38  
Kids praying for you.

Here are some paper,  
pencils, and Highlighters.

Love,  
Isabel



Dear People From Breezy Point  
I am a kid from Denver and  
My Teacher is Ellen I love  
accent its funny But I love her  
sorry for your homes but  
God will make something good out  
of. and God will protect you  
big or small! God Bless.

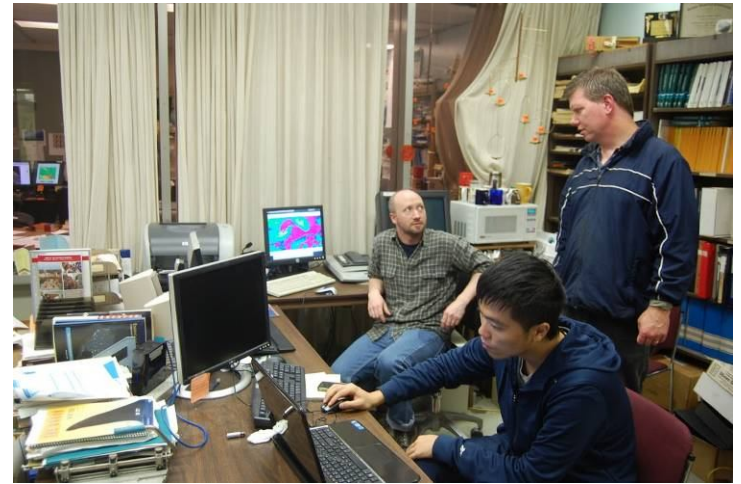
We are  
Praying  
for you



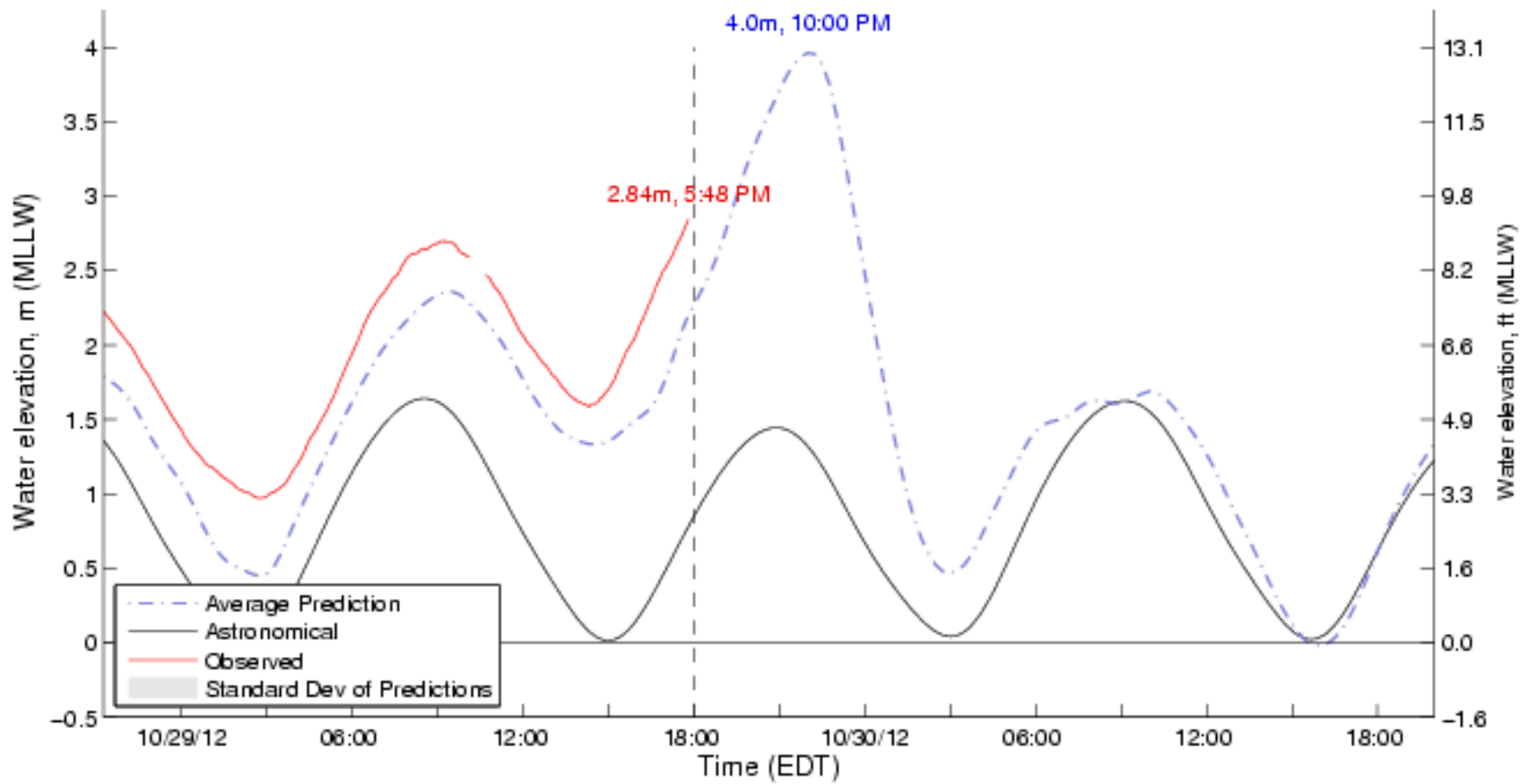


Water line on Irvine Ave.

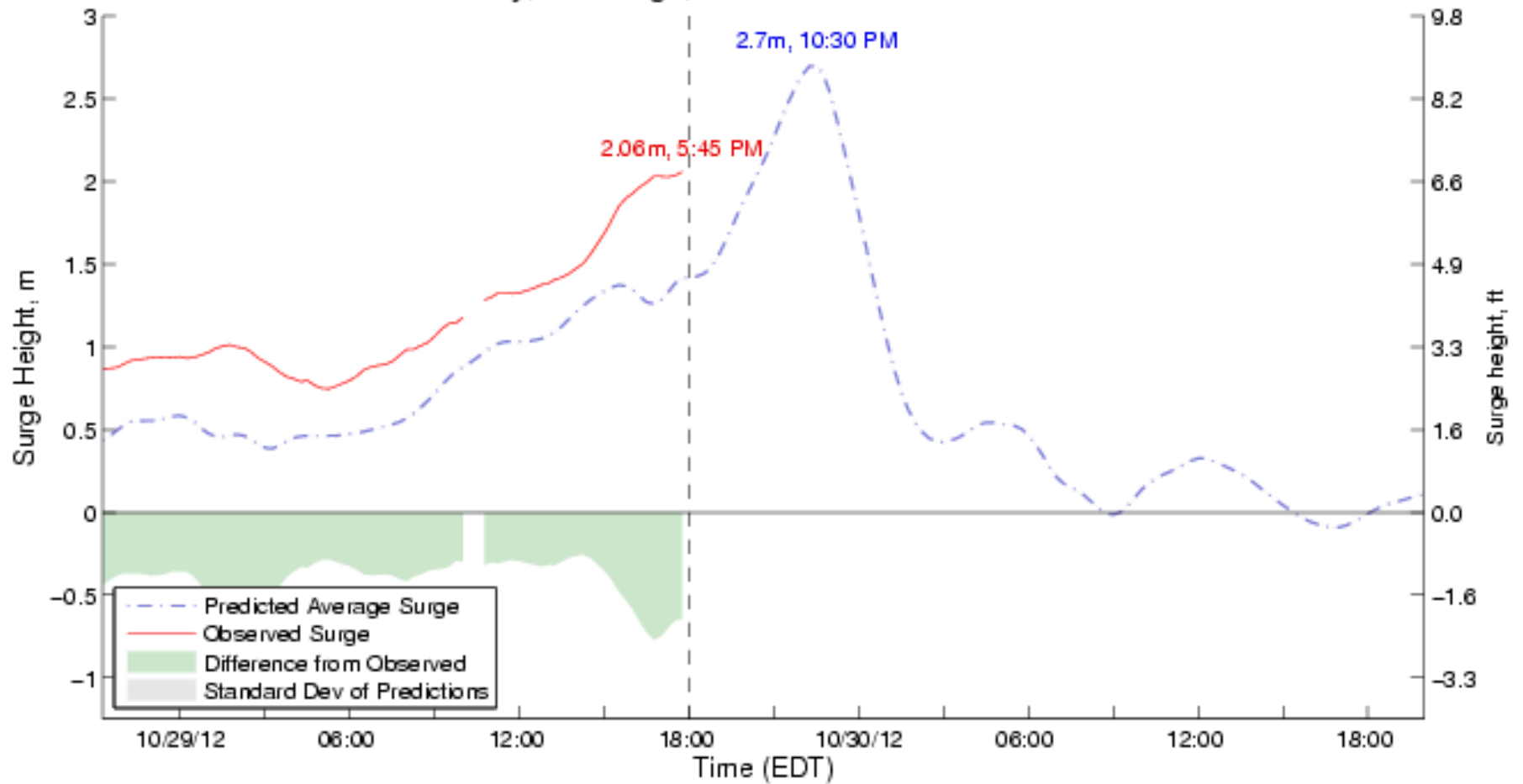


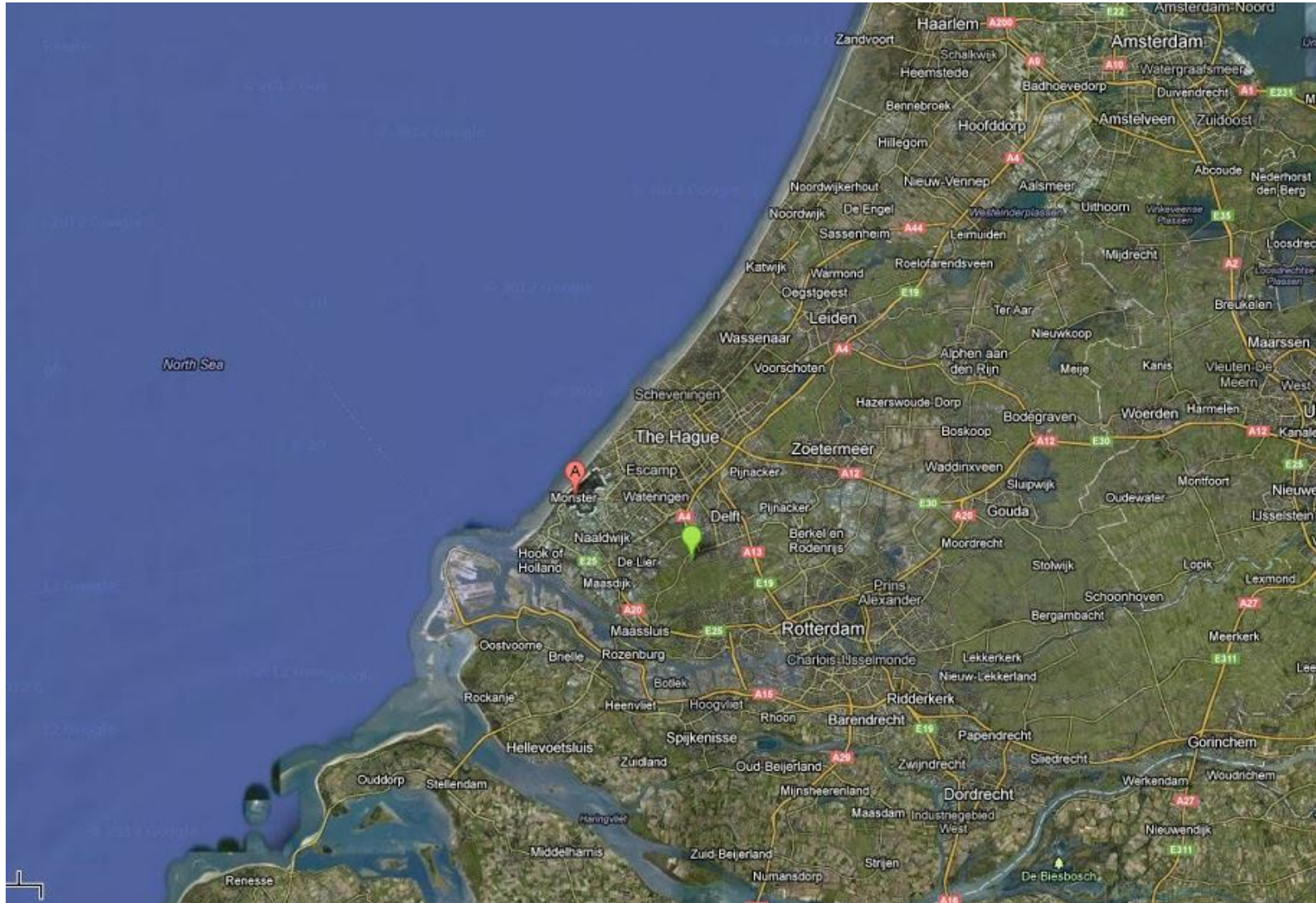


The Battery, NY water level, generated at 2012-10-29 18:00



The Battery, NY Surge, Generated at 2012-10-29 18:00









**Most foreign embassies in the Netherlands and 150 international organisations are located in the city, including the International Court of Justice and the International Criminal Court, which makes The Hague one of the major cities hosting the United Nations, along with New York, Vienna and Geneva <[http://en.wikipedia.org/wiki/The\\_Hague](http://en.wikipedia.org/wiki/The_Hague)>.**



**Netherlands: The seaside village of Strand Monster tucked in behind the high dunes.**



Signpost describing Zandmotor, the deposit of a huge amount of dredged offshore sand, spread along the coast (see top right of sign). The idea is that coastal waves and tides will redistribute the sand, thus widening and strengthening the beach dunes against future storm surges. The actual sand bar can be seen at the bottom right of the image.



**Distant view of the Zandmotor reclamation project, designed to strengthen the berm protecting this section of the southern coastline, near the town of Monster.**

# Stony Brook Storm Surge Research Group

A banner for the Stony Brook Storm Surge Research Group. The text "Stony Brook Storm Surge Research Group" is written in large, white, bold letters across the top. Below the text is a stylized, blue-toned image of a city skyline with buildings and a body of water.

## A City at Sea

By Malcolm J. Bowman  
Published: September 25, 2005

AS we read about the effects of Hurricanes Katrina and Rita on the Gulf states, we have to wonder if the same thing could happen to the metropolitan region. Scarily, it could.

New York City is not as low-lying as New Orleans, but much of it is less than 10 feet above sea level, including the perimeter of Manhattan's business district; the Lower East and West Sides; parts of the F.D.R. Drive; Bellevue hospital; coastal Queens and Brooklyn, including Coney Island, Rockaway, Jamaica Bay and La Guardia Airport; and the shores of the upper East River.

Across the Hudson River in New Jersey, Hoboken, Port Elizabeth, Newark Liberty Airport and Hackensack Meadows are particularly susceptible to flooding. During the December 1992 northeaster, ocean

## NEW YORK CITY IS PLANNING TO BE FLOODED

By Douglas Hill

3 September 2011

### Summary

New York City will inevitably be flooded in a hurricane, but instead of taking measures to prevent possible catastrophic consequences, it is aiming for "resilience." Other major coastal cities have erected storm surge barriers to prevent coastal flooding, and New York can be protected in the same way. The City should start by performing a comprehensive assessment of the risk of severe coastal flooding and the various alternatives for dealing with it, including storm surge barriers.



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

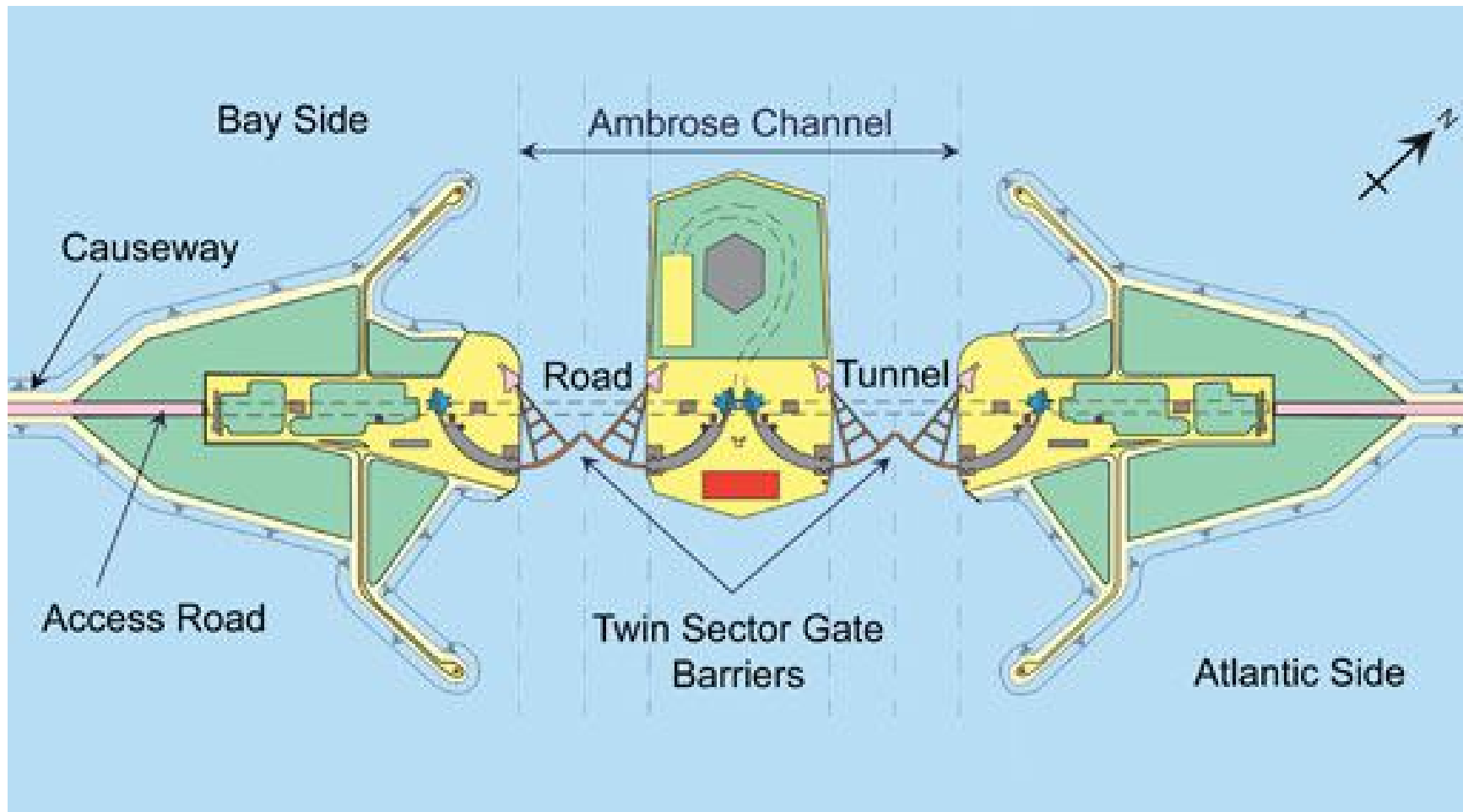


**Artist's impression of the proposed Outer Harbor Gateway, stretching 5 miles across the Sandy Hook – Far Rockaway transect (courtesy Halcrow). The red arrows show locations of sluice gates (next slide). The green arrows point to the three shipping gates (second slide on).**



**This structure is a combination highway/sluice gates at St Peterburg Russia. Five of these would be spaced across the outer harbor gateway shown in the previous slide (red arrows). The gates would normally be elevated to allow the free flow of the tides underneath, but dropped down to block surges during storms.**





Birds eye view of central shipping gates in outer harbor gateway. Two pairs of sector gate barriers close across the two shipping lanes during storms. Courtesy Halcrow.



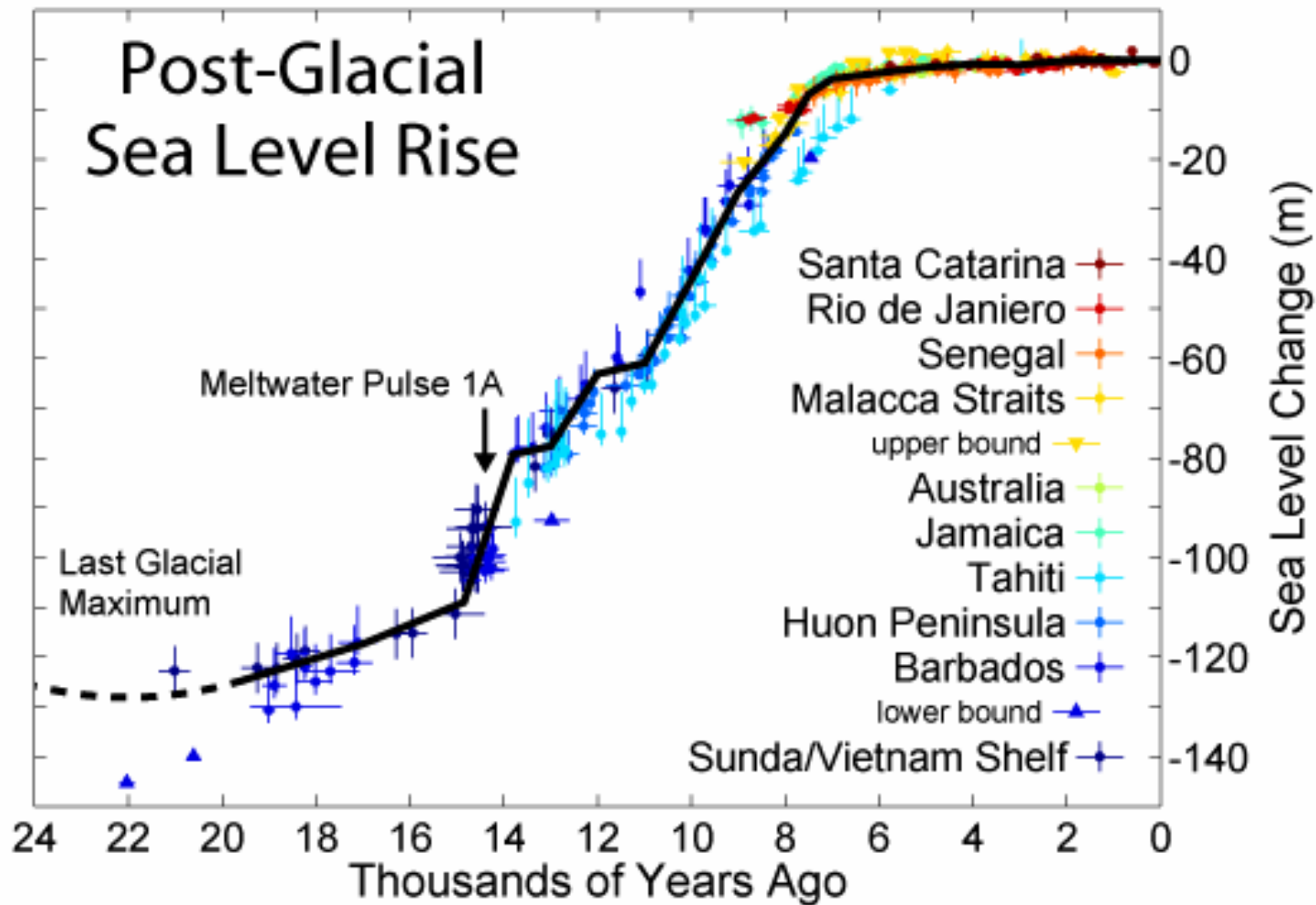
**Delta Works, the Netherlands. Twin sector gate barriers (Taintor Gates) protect the port of Rotterdam, the world's largest, against North Sea storm surges. The gates are shown closed in the storm surge position.<sup>42</sup> Normally the gates are kept open, rotated back into their parking areas.**



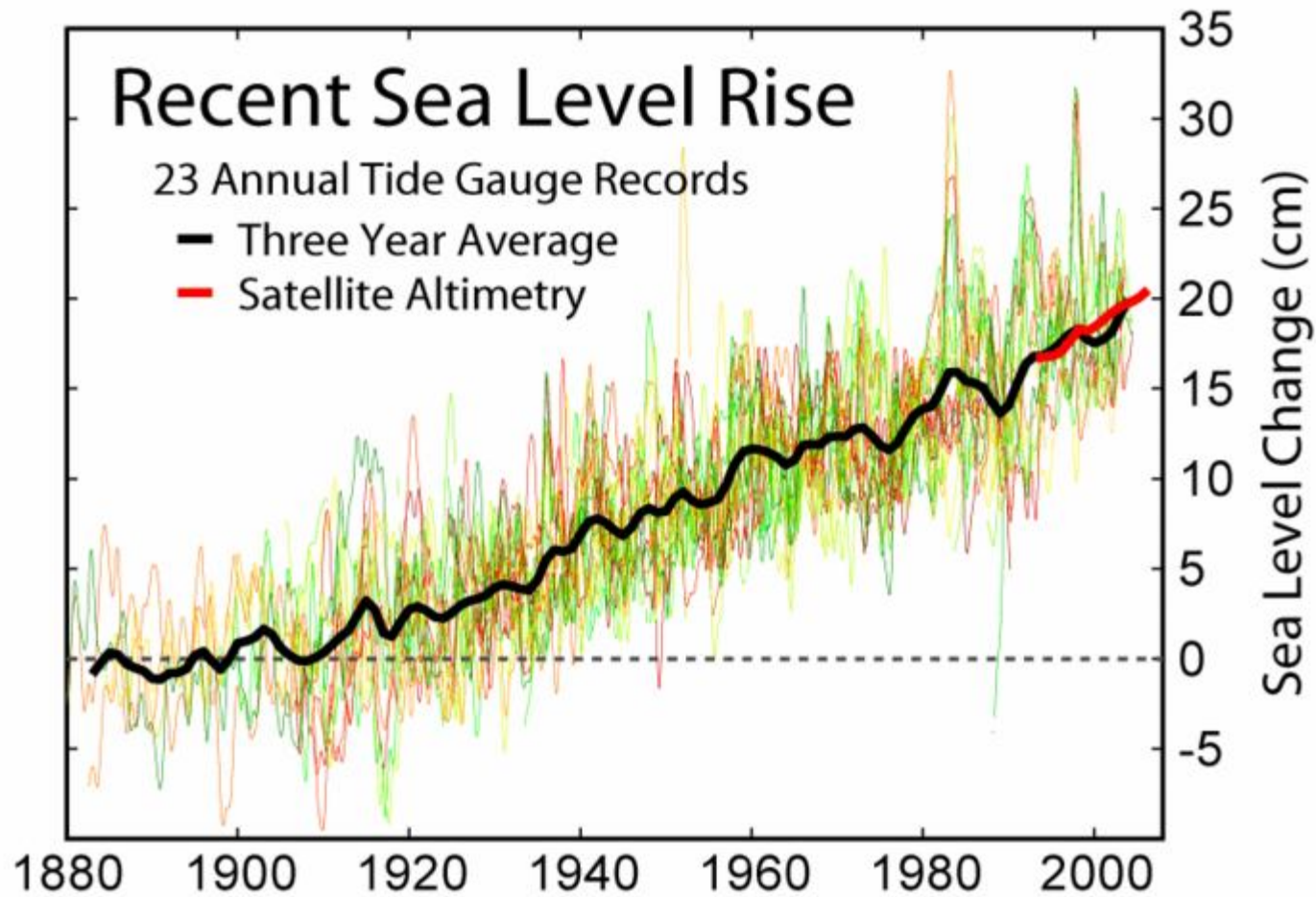
**Twin sector gate barriers under construction in St Petersburg, Russia.**

<http://www.nce.co.uk/news/water/st-petersburg-flood-barrier-russias-priceless-defence/5210144.article>

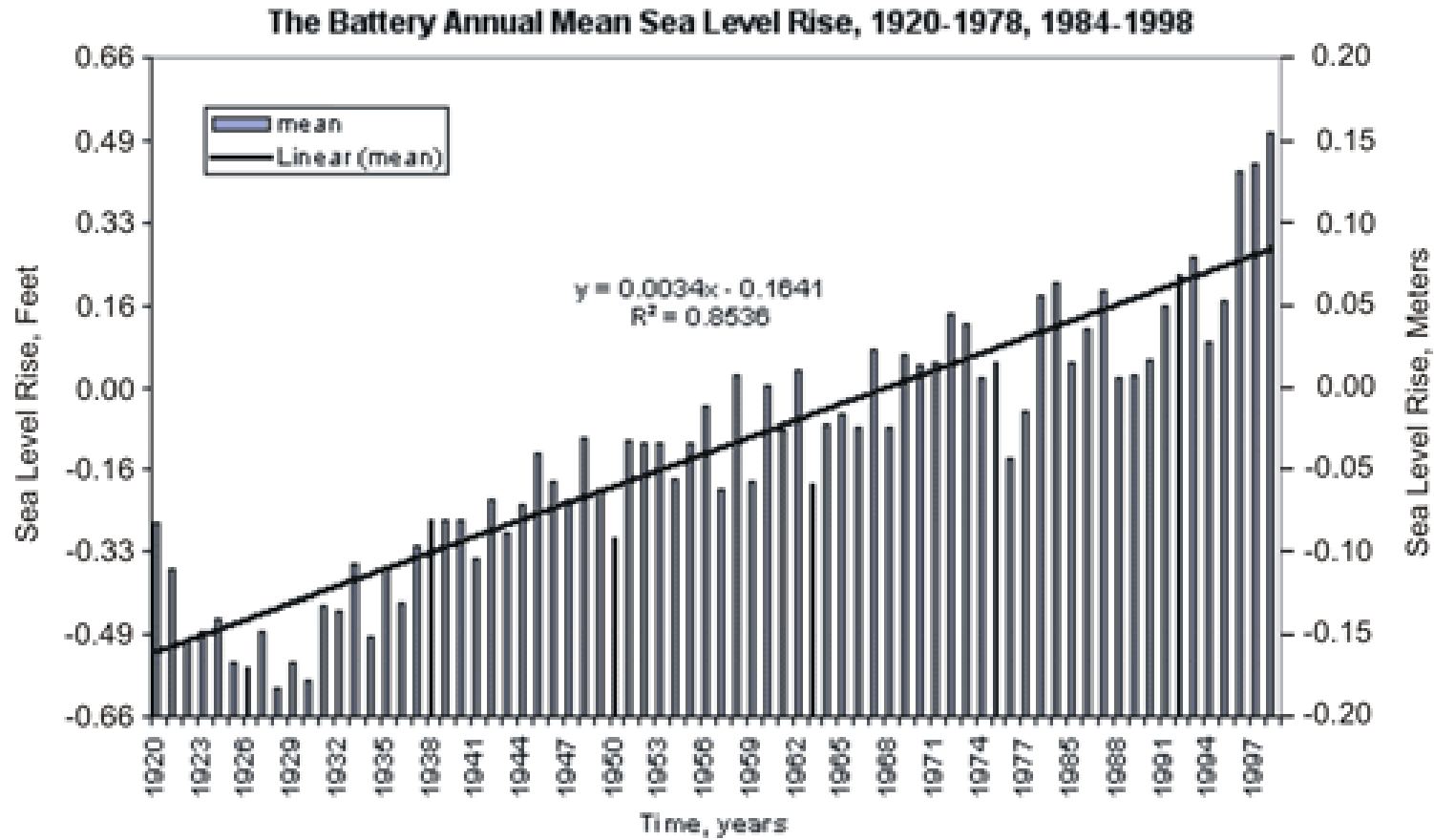
- 07 Nov 2012 [Post-Hurricane Sandy: What's Happening on Fire Island](#) *The National Park Service*
- 05 Nov 2012 [Massive barrier plan to save New York from flooding](#) by *Edward Helmore* *The Telegraph*
- 23 Aug 2012 [Year after Irene, New Yorkers ponder sea barriers](#) by *Jennifer Peltz* *Associated Press*
- 26 Jan 2012 [Storm surge 'prophet' warns of floods](#) by *Terese Loeb Kreuzer* *The Villager*
- 2011
- 29 Dec 2011 [A tide of concern is rising over risk of storm surges](#) by *Terese Loeb Kreuzer* *The Villager*
- 30 Nov 2011 [Hurricane Irene: New York City dodges a potential storm surge mega-disaster](#) by *Jeff Masters*
- 30 Aug 2011 [NYC's One-Inch Escape From Irene](#) by *Benjamin Strauss* *Huffington Post*
- 31 Aug 2011 [New York Times Blogs on NYSG-Funded SBU Researchers Tracking Hurricane Irene](#) by *New York Sea Grant, Stony Brook NY*
- 28 Aug 2011 [Will New York Be Lulled by Moderate Hurricane Surge?](#) By *Andrew C. Revkin*
- 28 Aug 2011 [Does New York City Need Surge Protection?](#) By *Andrew C. Revkin*
- 27 Aug 2011 [Irene Still Seen as Potent on N.Y. Arrival; New City Surge Estimate Serious, But Not Worst Case](#) By *Andrew C. Revkin*
- 26 Aug 2011 [Hurricane Irene – The Endgame](#) By *Andrew C. Revkin*
- 2010 and before
  - 8 Apr 2010 ["Are we prepared for our Katrina?"](#) by Diane Vacca, and ["Why is New York So Vulnerable?"](#). *Chelsea Now*.
  - 3 Jun 2007 ["Dam It! New York's Barrier Prophet Speaks"](#) by Lizzy Ratner. *The New York Observer*.
  - 11 Mar 2007 ["The Riddle of Changing Weather: How Safe is my Home?"](#) by Teri Karush Rogers. *The New York Times*.
  - 27 Nov 2006 ["Five Year Forecast"](#) by Clive Thompson. *New York Magazine*.
  - 9 Nov 2006 ["How to Keep New York Afloat"](#) by Moises Velasquez-Manoff. *The Christian Science Monitor*.
  - 5 June 2006 ["Storm surges threaten US economic heartlands"](#). by Patrick Berry. *New Scientist*, issue 1554.
  - Dec 2005 ["Storm Surge Barriers for New York Harbor"](#). New York Academy of Sciences. E-briefing (public version). [NYAS members-only version with featured audio and slides](#).
  - Nov/Dec 2005 ["Storm Surge Barriers for New York Harbor"](#) by Christine Van Lenten. Update (cover story - html). *New York Academy of Sciences Magazine*, pp. 6-9. (also available in [pdf format](#)).
  - Spring 2005 ["Closing the Doors on Storm Surges"](#) by Lane Smith. *Coastlines* , vol. 34, no. 1, pp. 6-7. New York Sea Grant, Stony Brook, NY.



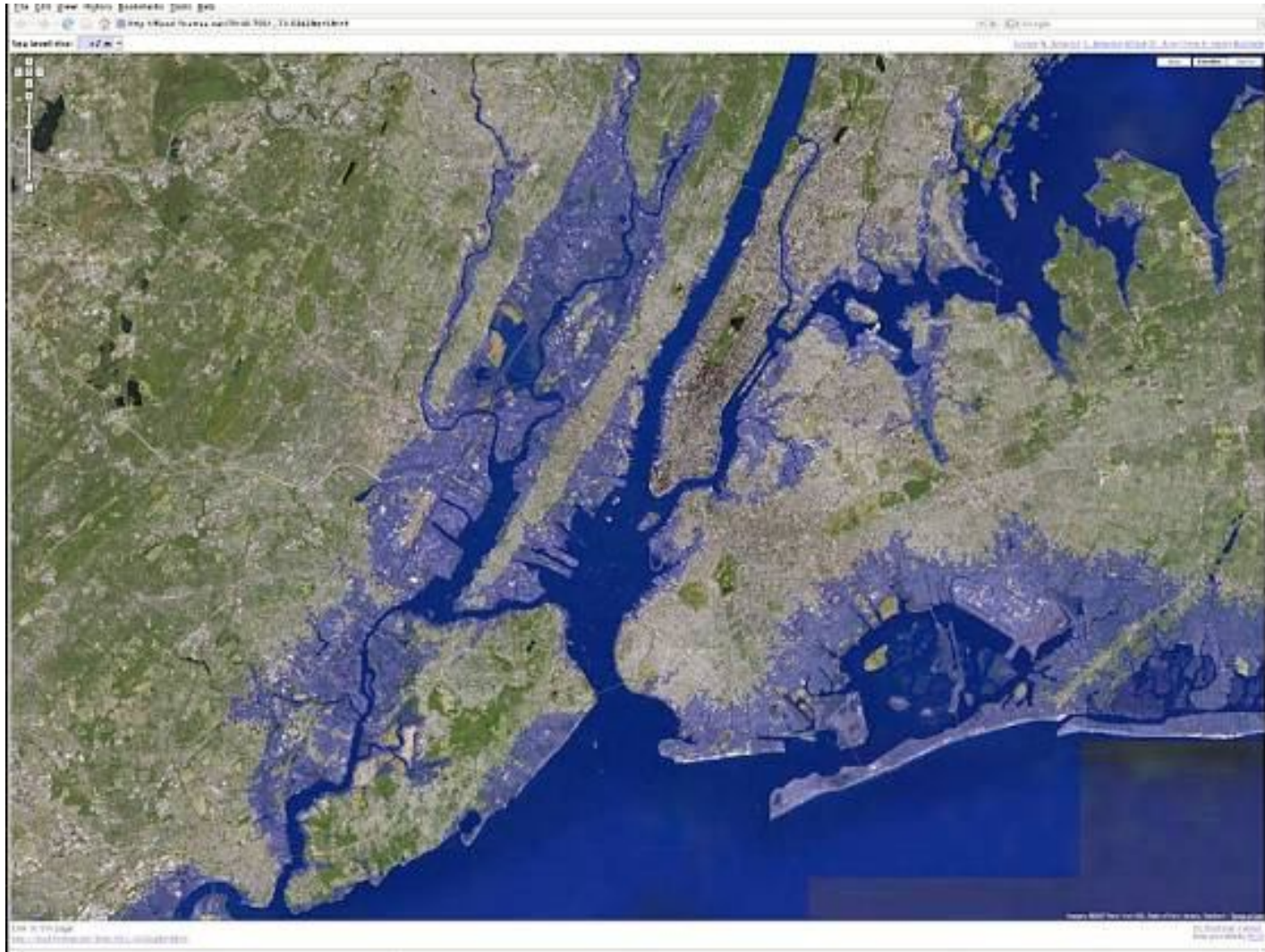
<http://www.emeraldecocity.com/Pictures/Post%20Glacial%20Sea%20Level%20Rise.gif>



<http://www.real-science.com/working-sides-sea-level-equation>



[http://www.oar.noaa.gov/spotlite/archive/images/nycplanning\\_fig2.gif](http://www.oar.noaa.gov/spotlite/archive/images/nycplanning_fig2.gif)



[http://blog.myplaceinthecrowd.com/wp-content/uploads/2008/03/google\\_earth\\_floodzones.png](http://blog.myplaceinthecrowd.com/wp-content/uploads/2008/03/google_earth_floodzones.png)



The New York Times

November 11, 2012

## A New Manhattan Project

By **BILL KELLER**

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

My friend and fellow columnist Joe Nocera, who grew up in Providence, R.I., thinks New York should look to that city's waterfront defense system of dikes and gates. My friend Andy Revkin, whose indispensable Dot Earth blog is where serious climate conversation takes place, prefers to emphasize more modest projects aimed at bolstering the city's resilience. New York's governor, Andrew Cuomo, has expressed interest in taming the surging sea. Mayor Michael Bloomberg sounds more skeptical.

It's enough to send you down a deep hole of denial — which, I fear, is where the whole question of New York's survival will end up without a public outcry or a feat of leadership. The problem is not just that smart people differ wildly about what to do; it's that the problem crosses multiple jurisdictions, that everything costs loads of money and that humans have short memories. The will to do anything ambitious tends to recede almost as fast as the tide surge.

But this is no time for fatalism or forgetting. While victims are still digging out, while the costs are still adding up, now is the time to set big things in motion. When President Obama visits this week, he has an opportunity to address not just the misery before his eyes, but the magnitude of the future threat it represents and the scale of the commitment required. Leading the world in the effort to curtail climate change is a moral obligation to our descendants, but there is an equally urgent need to defend against the consequences of the damage already done to our poor biosphere. At the risk of slighting the brutalized communities of the Rockaways and the Jersey Shore, I'll call it a new Manhattan Project. It would make someone a fine legacy.

I've spent some time talking to people who study weather disasters from different angles, and I'm looking for a leadership to-do list. Here's where I'd start:

**Come together.**

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## CONCLUSIONS

- We can expect more extreme weather events in the future as climate change takes hold.
- Rising sea level means that future flooding events will be more severe than ever. What we experienced during Hurricane Sandy will occur again (and again).
- Nothing is forever, but we must stand and fight the challenges of climate change and what it means for Long Island and Metro New York.
- Eventually we will have to abandon the Island as we know it, but not in our lifetime, but perhaps in our great-grandchildren's lifetimes.
- For the next 150 years there are many treatments we can undertake to reduce the trauma of climate change and rising seas – but they will eventually fail.
- Now is the time for vision, political will and bold ideas to save our cities and communities as long as it is practicable.

Thank you.