Changes in Hudson River sediment distribution after storms Irene and Sandy

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Outline

• Tropical storms Irene and Sandy
• Available pre-storm data (Hudson River Benthic Mapping)
• Collection of post-storm data
• Sediment cores and sediment sources
• Thickness Changes in subbottom data
• Summary
• Next steps
Storms Irene and Sandy

Irene Aug 28 2011
Sandy Oct 30 2012

Different paths => Different effects

Source: Nat. hurricane Center
Different Effects of Irene and Sandy

Irene - Sediment Input

Before Irene

After Irene

From TechEBlog.com

Sandy - Coastal Surge

Before Sandy

May 21, 2009

After Sandy

November 5, 2012
Discharge and Sediment Input From Irene and Lee

Ralston et al 2013; USGS Wall, 2011
Suspended Sediment Load from Tributaries

Catskill
Rondout
Kinderhook
Normanskill*
Esopus
Roeliff Jansen

Total = 1,160,000 tons

* Irene only

Source: Gary Wall, USGS
Dan Miller (slideshare.org)

=> Large Contribution from Tributaries
Suspended Sediment Load During Irene

Total suspended sediment: ~2.7 Mt

(~ 1Mt remained originally north of Poughkeepsie)

http://ny.water.usgs.gov/gmaps/HudsonSedNet.html
Objectives / Questions

- What happened to the sediment?
- Is it stored at the depositional areas?
- Can we distinguish sediments from different tributaries?

Why do we care?
How to hide a million tons of sediment?

1 million tons => ~3 cm thick

1 million tons => ~5 cm thick

(equally distributed over entire area, 55% water content, 640 kg/m³)
Hudson River Benthic Mapping Data

Data Acquisition

• From 1998 and 2004
• New York Harbor to Troy Dam
• Multibeam bathymetry data
• Subbottom and sidescan data
• Sediment cores and grabs

Results:

• Sediment grain size distribution
• Sediment environments
• Areas of deposition
Hudson River Benthic Mapping – Areas of Deposition

Use as:

- Baseline for comparison
- Guidance for survey planning

=> New sediment might be stored in high deposition areas

Nitsche et al. 2005
Selection of Study sites

- Known Depositional Areas
- Sediment might be stored near major sources:
  - Rondout Creek
  - Esopus Creek
  - Catskill Creek
Approach

- New Subbottom data
- New Sediment cores

-> compare with old locations

Example: Haverstraw Bay
HR1401 Sediment Core Examples

HR14-05GC

HR14-12GC

HR14-34GC
Pb Profile Approach

![Graph A](image1.png)

![Graph B](image2.png)
Pb Profile Approach
Pollution Chronology
Constraints on deposition timing
HR1401 Sediment Core Analysis
Seismic Data Comparison

Example: Haverstraw Bay

Total: 168 new seismic lines
Results of Seismic Data Comparison

- Difference along lines
- Gridded change
Comparison with Long-Term Deposition

20th century deposition

2001 – 2014 change

Nitsche et al, 2013
Haverstraw Bay Pb Profiles

change / m

< - 0.5
-0.49 - -0.25
-0.24 - -0.1
-0.09 - 0
0.01 - 0.1
0.11 - 0.25
0.26 - 0.25
> 0.5

depth contours every 5m
Thickness Results – Haverstraw Bay

- Deposition not uniform
- Deposition in main channel (mostly in dredged channel)
- Erosion at some locations
- More deposition than expected from long-term (0.1 - 0.3m vs 0.01 – 0.1m)
Thickness Results – Newburgh Bay

- Only small area surveyed
- Deposition at edge of main channel
- Erosion in center channel
Thicknes Results – Kingston south

- Larger deposition areas
- Variation of deposition and erosion
- Uncertainty near seep slopes
Thicknes Results – Kingston north

- Effects of migrating sand bars and sediment waves
- Variation of deposition and erosion
Thickness Results – Kingston - Esopus

- Effects of migrating sand bars and sediment waves
- Variation of deposition and erosion
Thicker deposits near tributary

Effects of migrating sand bars and sediment waves

Variation of deposition and erosion
Comparison with Model

Ralston et al. 2015
Comparison with Model

Ralston et al. 2015
Sediment Source Work

• Chemical analysis made on >600 archived surface samples provides background levels

• Compare to newly deposited material

• Compare to material from specific tributaries
Chromium Example

![Chromium Example Graph](image)
Conclusions/Summary

- Deposition layer in sediment cores
- Changes in seismic data
- Area of significant deposition (pattern rather real volumes)
- Not a uniform distribution
- Other process effect sediment changes (moving sand bars and sediment waves)
Next Steps / Future work – XRF scanner

• Higher resolution profiles of metals
Future work – Compare with New Surveys

- NOAA multibeam bathymetry surveys (started 2015, ongoing)
Future Work

• More detailed comparison with WHOI model

• Improve Sediment Characterization in Tributaries
Thank You

Questions?