Impact of Hurricane Sandy on the Geomorphology of Sunken Meadow, NY

Joe Tamborski (joseph.tamborski@stonybrook.edu)
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Introduction

• Shoreline erosion and accretion rates are important for determining dredging intensity and frequency, a costly process.
• Nissequogue River inlet was last dredged in 2009 (Walsh 2013).
•Gibson & Cushman are dredging approximately 93,000 cubic yards of sediment for $2.09 million (Harrison 2013) this winter at the Nissequogue River inlet.
• The purpose of this project is to estimate the area of sand that has been lost and gained after Hurricane Sandy made landfall on Long Island and the storm's impact on the geomorphology of the region.

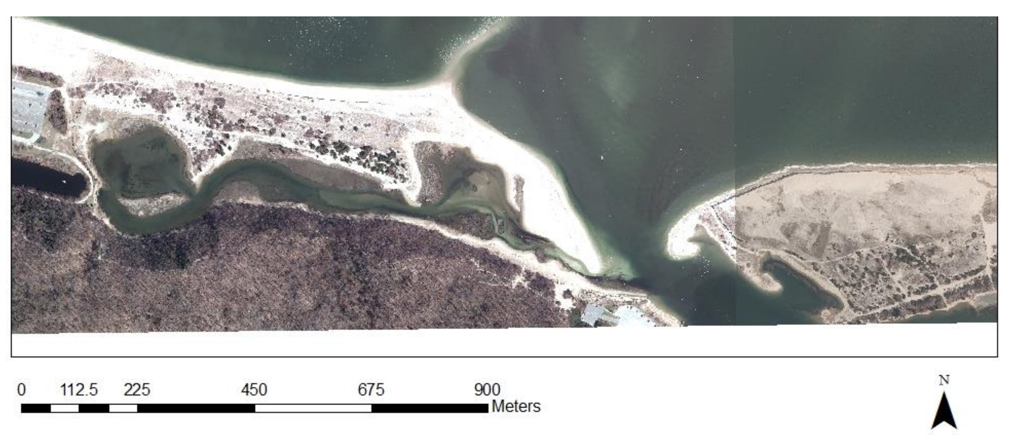

Figure 1. Study site Sunken Meadow State Park, which encompasses Sunken Meadow Creek, and Nissequogue River inlet. Image shown is a pre-storm ortho-rectified imagery from 2010.

Methods

- Images are acquired pre-storm (2010 ortho-imagery) and post-storm (2013) airborne visible and thermal infrared imagery (Rodriguez et al. 2009).
- Airborne images are georectified.
- The shoreline in pre-storm and post-storm images are delineated following methods outlined by Boak et al. (2005) into separate feature classes.
- Map algebra is used to calculate new raster files (Armaroli et al. 2006, Dolch 2010), where:

(1) *Sand in both images = Post-storm raster – Pre-storm raster*

(2) *New raster (50) = Post-storm raster (40) + Pre-storm raster (10)*

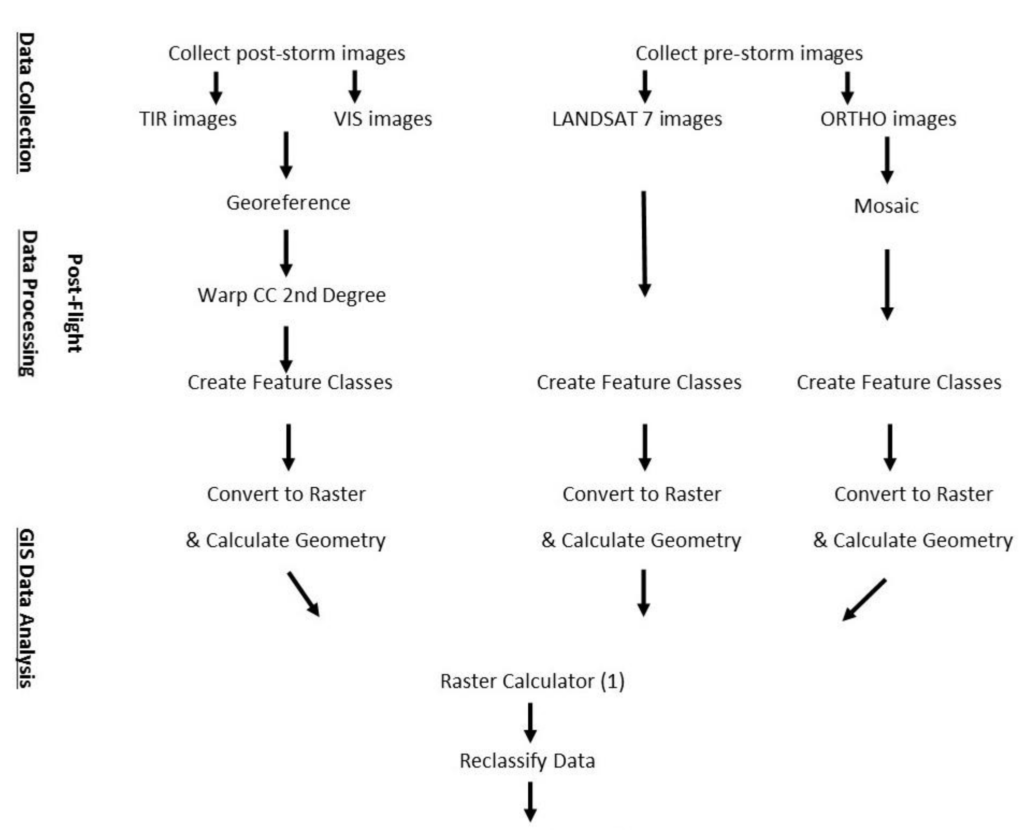

Figure 2. Workflow for methodology presented in this analysis.

Results

Figure 3. Area of Sunken Meadow Creek that has been lost due to Hurricane Sandy, approximately 700 m^2. Loss of land has allowed Sunken Meadow Creek to experience full tidal exchange with Long Island Sound, which will help restore the water quality and ecology of the creek over time back to natural conditions.

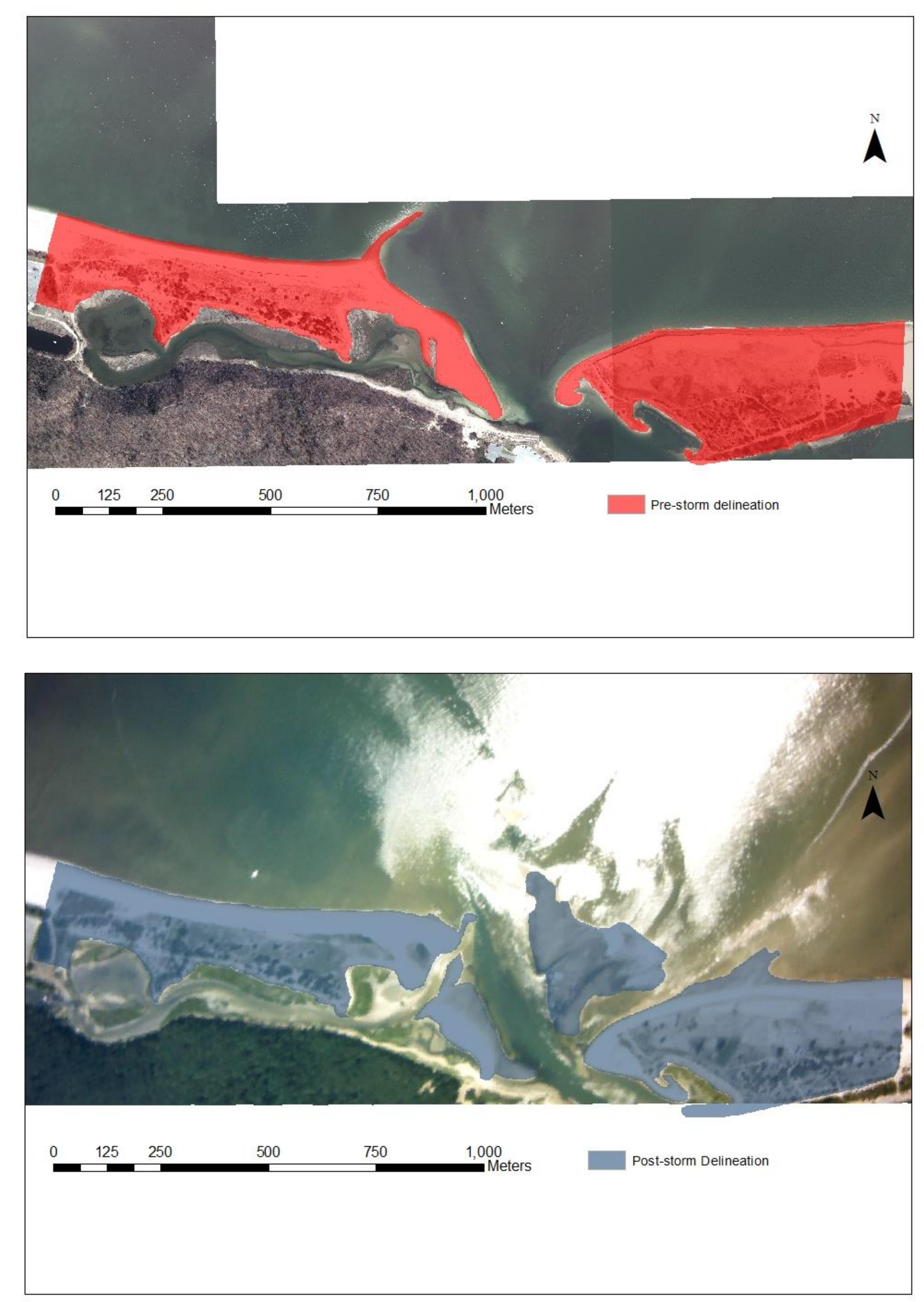

Figure 4. Areas of Sunken Meadow that have been delineated based on the location of man-made, fixed objects, following the methods outlined by Boak et al. (2005). Top figure represents delineated area prior to Hurricane Sandy using ortho-imagery. Approximate area = 429,000 m^2. Bottom figure represents delineated area post Hurricane Sandy using aerial visible imagery, taken in August 2013. Approximate area = 669,000 m^2.

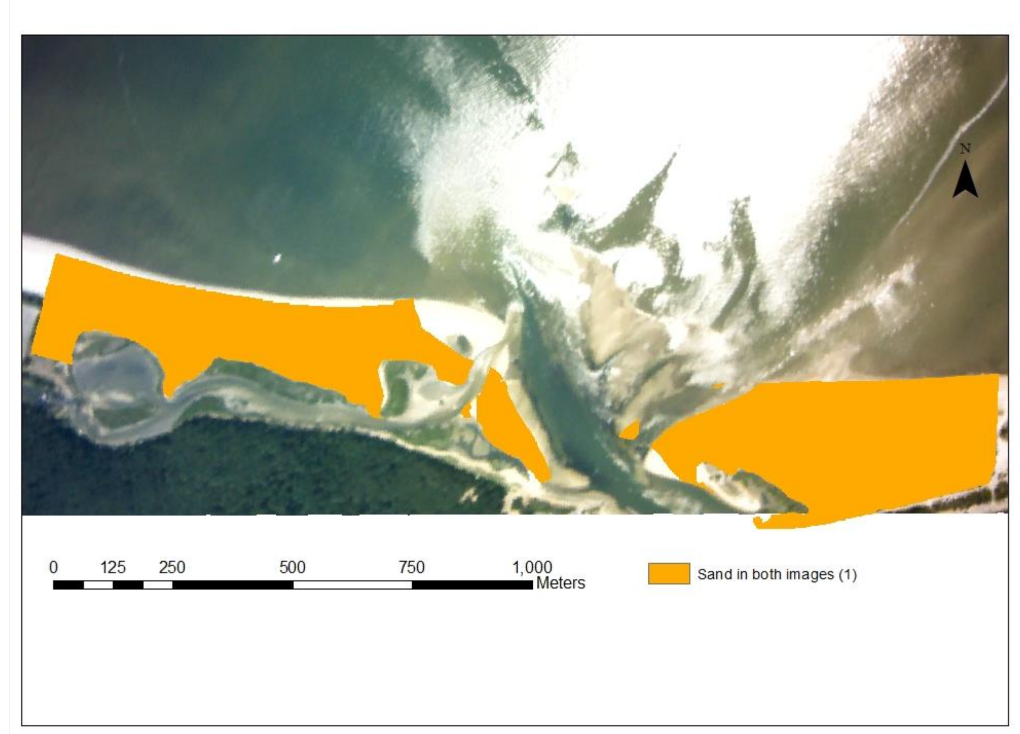

Figure 5. Sand that is present in both pre-storm and post-storm images, as calculated using equation (1). Approximate area = 312,000 m^2.

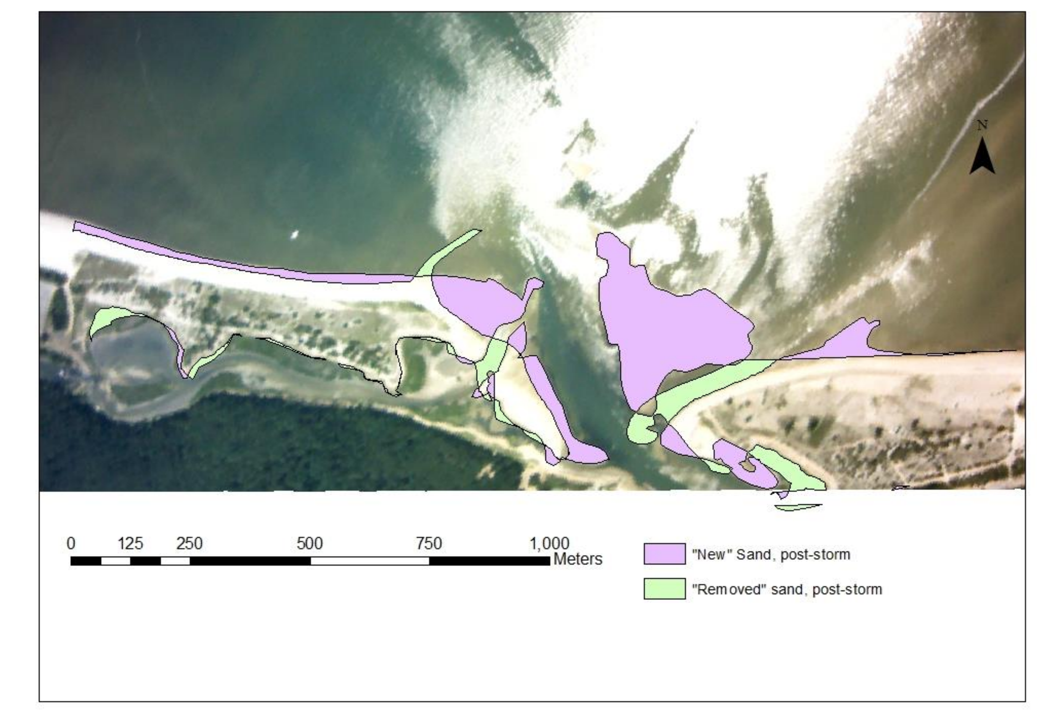

Figure 6. Estimated "new" and "removed" sand, as calculated using equation (2) and a conditional statement. Approximate area of "new" sand = 47,000 m^2. Assuming sand has been deposited to a depth of 2 m, the estimated volume of new sand added from Hurricane Sandy is approximately 94,000 m^3.

Conclusions

- The volume of estimated sand added from Hurricane Sandy using the methods employed in this analysis is approximately 94,000 cubic meters.
- Private contractor Gibson & Cushman have estimated that they will remove approximately 93,000 cubic yards of sediment from the river inlet this winter, suggesting that the presented analysis was fairly accurate in estimating the net new input of sand to the inlet and surrounding areas.
- The methodology used in this analysis is a useful way for calculating area of sand masses that have been either gained or lost after a significant storm event, such as Hurricane Sandy.

Recommendations

- Use of thermal infrared (TIR) imagery should be used in future analyses to better define the beach face for a more accurate analysis.
- Future analyses should utilize images that have been taken at the same tidal stage to reduce any error associated with sand that is exposed at a lower tidal stage.
- High resolution aerial imagery should be used for detailed analyses. LANDSAT-7 data is inadequate for an analysis such as this, but may be useful on a more nation-wide scale (i.e. Wang et al. 2013).

References

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