

Insights into the Impact of Tropical Systems on Tidal Marshes: Results from High Frequency Monitoring in a Constructed Marsh During Hurricane Sandy

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Introduction

- Unknown source, fate, and dynamics of sediment brought into tidal marshes by tropical storm systems
- Novel automatic water quality probes can capture extreme events without safety risks to researchers
- 14 ha of constructed brackish marsh and 1000 m of tidal stream designed for habitat creation and treatment of excess nutrients (Fig. 1)

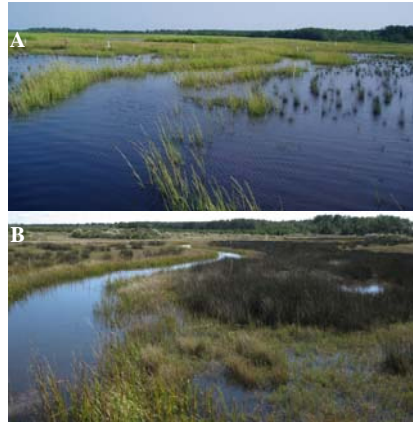


Figure 1. Constructed marsh in North Carolina in A) September 2007 B) November 2012. The marsh was planted during June 2006.

Research Questions

- Can ultraviolet-visual spectrometers be used to measure TSS concentrations in a brackish tidal marsh?
- What is the source of TSS to the marsh during extreme weather events?
- How much and following what dynamics were TSS imported during Hurricane Sandy?

Concentration Dynamics

- During normal tides, highest TSS concentrations observed at low tide (Fig. 4 and 5A)
- During Hurricane Sandy, the highest TSS concentrations occurred during the peak flooding flow (Fig. 4 and 5B)
- High salinity during the peak TSS concentrations indicate estuarine or ocean source of sediment to the marsh (Fig. 5B)
- Largest spike in TSS occurred the first time the stage dropped below bankfull following Hurricane Sandy

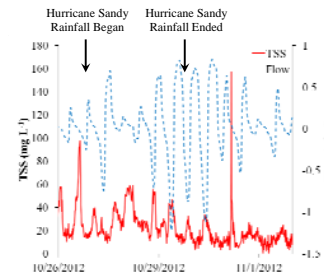


Figure 4. TSS concentrations and flow at the downstream station before and during Hurricane Sandy. Positive flow is from the marsh to the estuary and negative flow is from the estuary to the marsh.

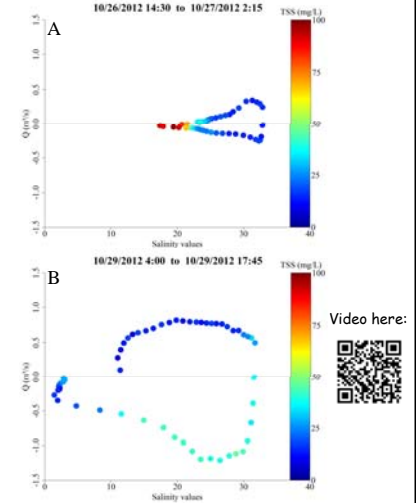


Figure 5. Flow, salinity, and TSS concentrations during a single tidal cycle A) prior to Hurricane Sandy B) during the time when the influence of Hurricane Sandy was the greatest. Positive flow is from the marsh to the estuary and negative flow is from the estuary to the marsh.

Continuous Monitoring Methods

- **Approach:** mass balance in the marsh from TSS load measurements at the upstream and downstream stations (Fig. 2)
- TSS loads calculated from 15-min flow (Doppler flowmeters in trapezoidal flumes) and concentration data

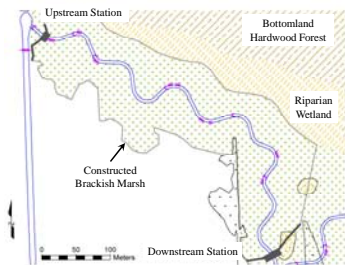


Figure 2. Studied 5.6 ha marsh and 660 m tidal creek isolated between monitored stations

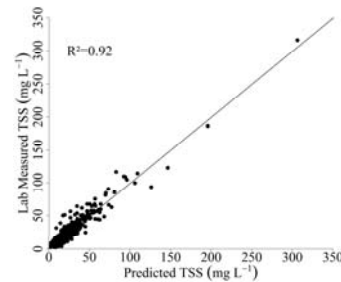


Figure 3. TSS concentrations predicted using PLSR calibration and spectrometer output compared to the lab measured concentrations.

- 15-min concentrations obtained from Partial Least Squares Regression (PLSR) between light absorbance measured by a spectrometer and discrete sample concentration values (Fig. 3)

Mass Balance Results

- Very little TSS imported through the upstream station (Fig. 6): flat land and no-till practices upstream
- Most of the TSS imported through the downstream station during flooding tides of the hurricane (Fig. 5 & 6)
- Marsh as TSS sink: 14% (345 kg) of the total TSS load retained
- Combined mass balance was nearly neutral prior to the hurricane (Fig. 6)
- Major import occurs during tidal cycles where the stage was above bankfull
- Steady TSS export after hurricane

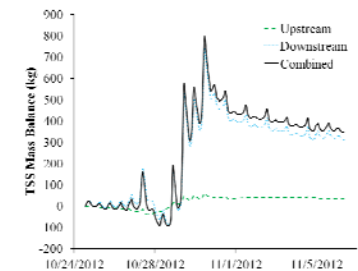


Figure 6. Net mass balance during the monitoring period that included Hurricane Sandy. Positive values indicate retention and negative values indicate release.

Summary

- UV-Visual spectrometers can be used to measure TSS in brackish marshes
- Tropical storm systems dramatically modify TSS dynamics and loading to tidal marshes
- Source of TSS to the marsh during Hurricane Sandy was the estuary or the coastal ocean
- The marsh retained 345 kg of TSS during Hurricane Sandy

Poster available at:



More information on the marsh results at:



Research Funded by:

