Roles of Short-term Water Level Fluctuations in the Lower Green Bay and Fox River Area of Concern

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Motivation

- Sediment-associated contaminants (e.g. PCB)
- Explosive algae growth due to nutrient loading
- Short-term water level oscillations (STWLOs)

Map of Great Lakes Areas of Concern [WDNR, 2013]

Algal bloom in Green Bay [SSEC, 1999]

CAUTION CONTAINS PCBs
(Polychlorinated Biphenyls)
A toxic environmental contaminant requiring special handling and disposal in accordance with U.S. Environmental Protection Agency Regulations 40 CFR 761 for disposal information contact the nearest U.S. E.P.A. Office.

In case of accident or spill, call the U.S. Coast Guard National Response Center 800-424-8802

Also contact Tel. No. 224-8802

River flow
Tides
Bidirectional flow
Seiches
Transport processes

- Bidirectional flow will reverse river flow and transport nutrients and sediments to upstream

Nutrients
Sediments
Objectives

➢ Characterize the *temporal* and *spatial* patterns for short-term water level oscillations.

➢ Reveal the role of the short-term water level oscillations on *velocity* and *residence time* for sediment transport.
Approach

- Observational data
  - 6-min water level
  - 1-min wind & pressure
  - 5-min water level & discharge

- Time series analysis

**Fast Fourier Transform and Harmonic Analysis**

Tidal constituents

![Diagram of tidal constituents]

Time

Frequency
Multi-time scale water level oscillations

Fox River Estuary

Long-term
Climate

Seasonal
River flow
Density-driven

Short-term
Daily
Tides
Seiches

Hourly
Meteorology
forcing
Tides and Seiches contribute to short-term oscillations.
Tide induced water level oscillations

Tide is significant inside Green Bay

47.7% of total short-term water level oscillations

[Graphs and diagrams showing water level oscillations and tidal influence on Green Bay.]
Hydrodynamic model

- 3D Hydrodynamic Model - SCHISM
  
  Mesh resolution: 20 to 150 m

  Forcing: Inflow Discharge & Water Level

  Wind & Pressure

  Adjoint method for Open Boundary
Hydrodynamic model

- Model validation
Velocity map

Large upward velocity (~0.5m/s) is caused by STWLOs

Max. Downward Velocity

Max. Upward Velocity
Summary

Tides and Seiches are the main causes of STWLOs

STWLOs cause large upward velocity

Ongoing works: modeling sediment and nutrients transport and residence time with particle tracking model