



Health



Environment



Technology



Sustainability

Integral Consulting Inc.

Optically Based High-Resolution Chemical Monitoring

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Introductions

- Craig Jones, Ph. D.—
Principal ocean and
environmental engineer
- Grace Chang, Ph. D.—
Managing scientist and
optics expert
- Frank Spada —Ocean
engineering technician
- Todd Martin, P.E.—
Environmental engineer
and hydrogeochemist



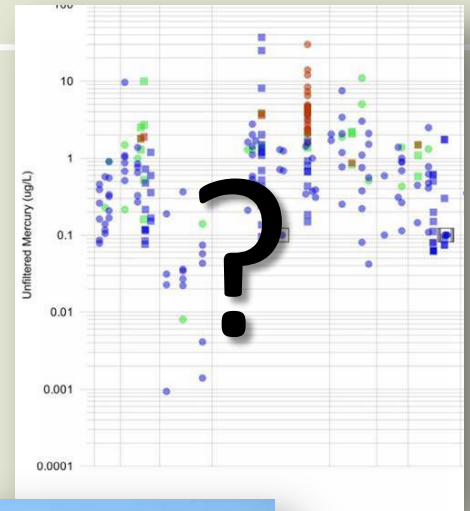
Optically Based Chemical Monitoring

- **WHAT:**
 - Instruments measure the response of light propagation through water
 - Optical water monitoring techniques have been in use for decades
- **HOW:**
 - Optical characteristics can be correlated to water quality parameters, most recently environmental contaminants
- **WHY:**
 - Provides unprecedented data resolution at low costs



Why Optically-Based Monitoring?

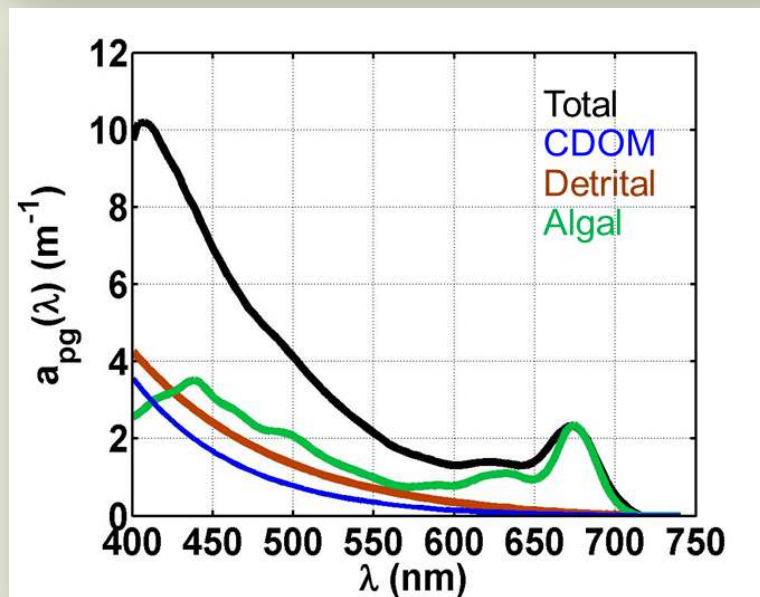
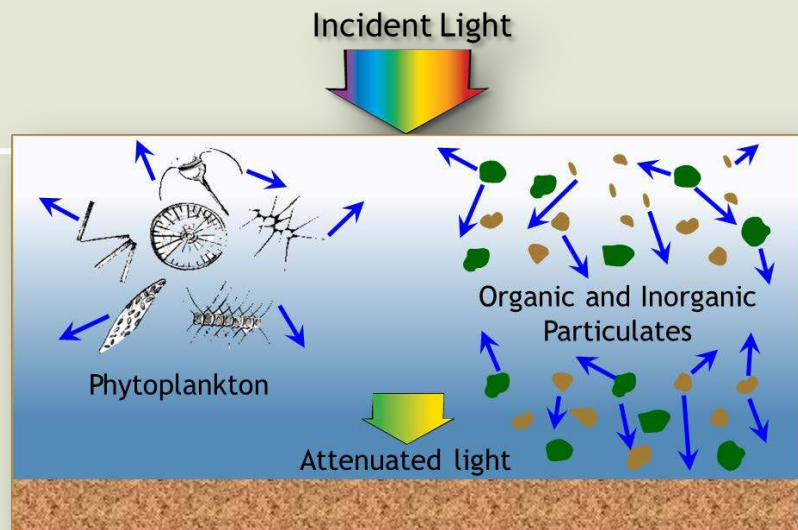
- Conventional sampling often leads to *high cost* and *low utility* data
- Optical monitoring provides:
 - High temporal resolution
 - Large volume of data
 - Complete characterization at substantially lower overall cost than conventional techniques



Optics — The Basics

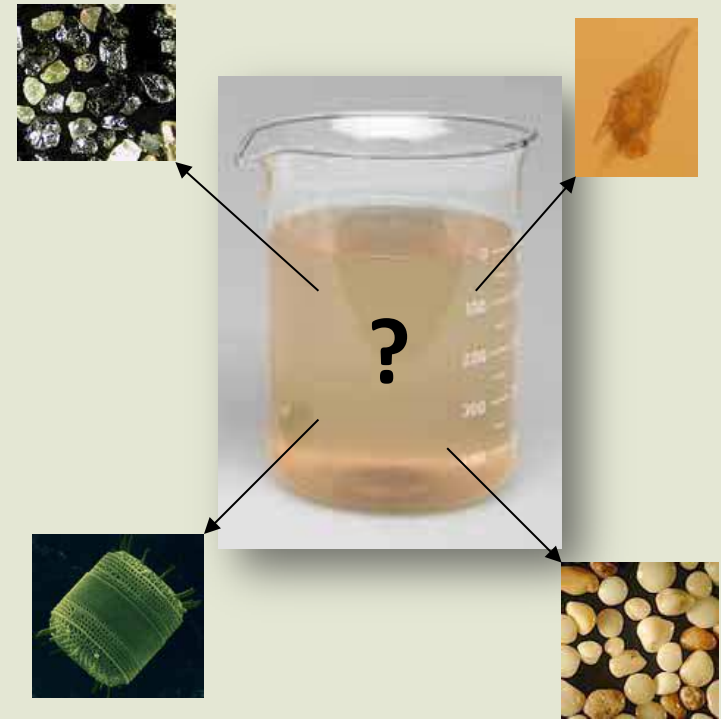
- Optical instruments measure the response of light propagation through a volume of water

- Spectral absorption
- Spectral attenuation
- Backscattering
- Fluorescence



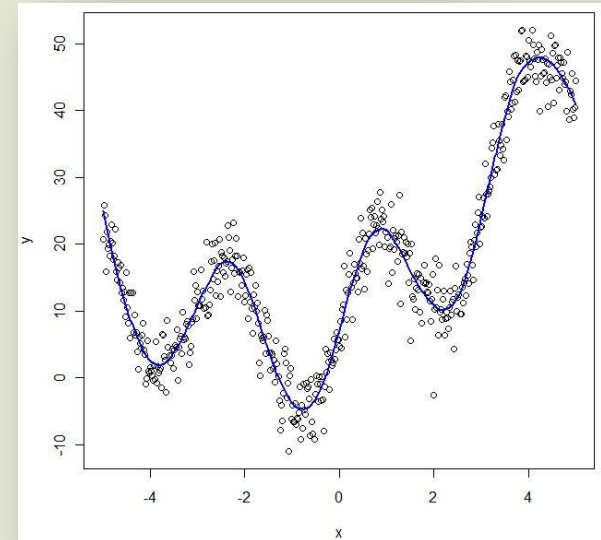
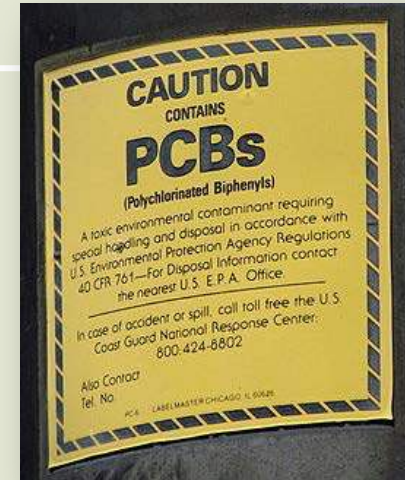
Optical Properties Have Been Successfully Used to Determine Many Parameters

- Dissolved organic carbon (DOC)
- Particulate organic carbon (POC)
- Total suspended solids (TSS)
- Biomass
- Nutrients
- Particle size
- Particle composition



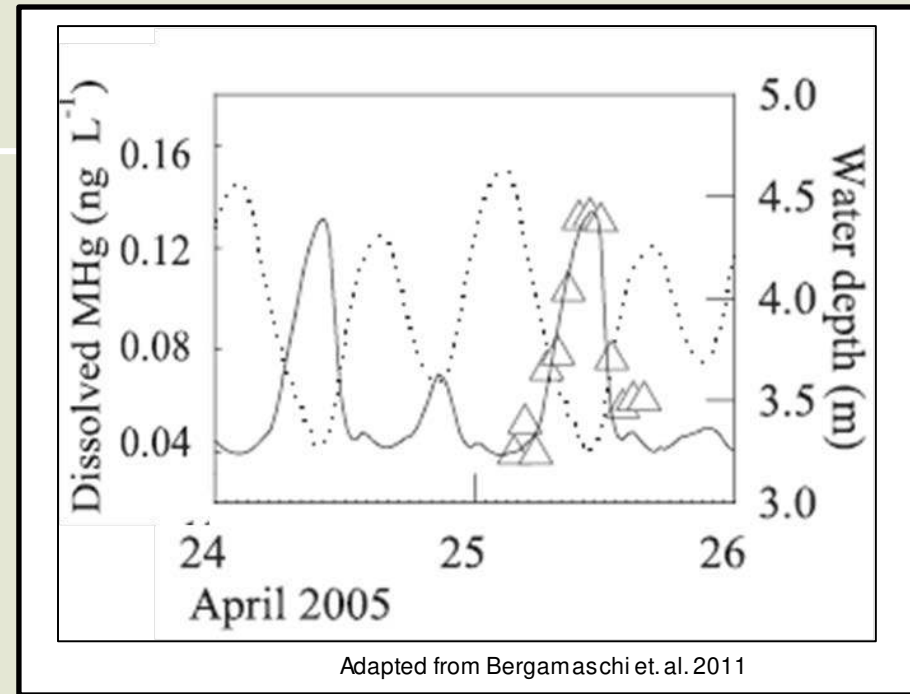
How Does This Work for Environmental Contaminants?

- Many contaminants associate with:
 - Suspended solids
 - POC
 - DOC
- Optical model is developed:
 - A statistical model is used to develop robust correlations between the optical properties and contaminant concentrations



Approach Developed by USGS

- Bergamaschi et al. characterized mercury and methylmercury
 - San Francisco Bay
 - Florida Everglades
- Proven for:
 - Dissolved and particulate mercury
 - Dissolved and particulate methylmercury
 - Particulate PCBs



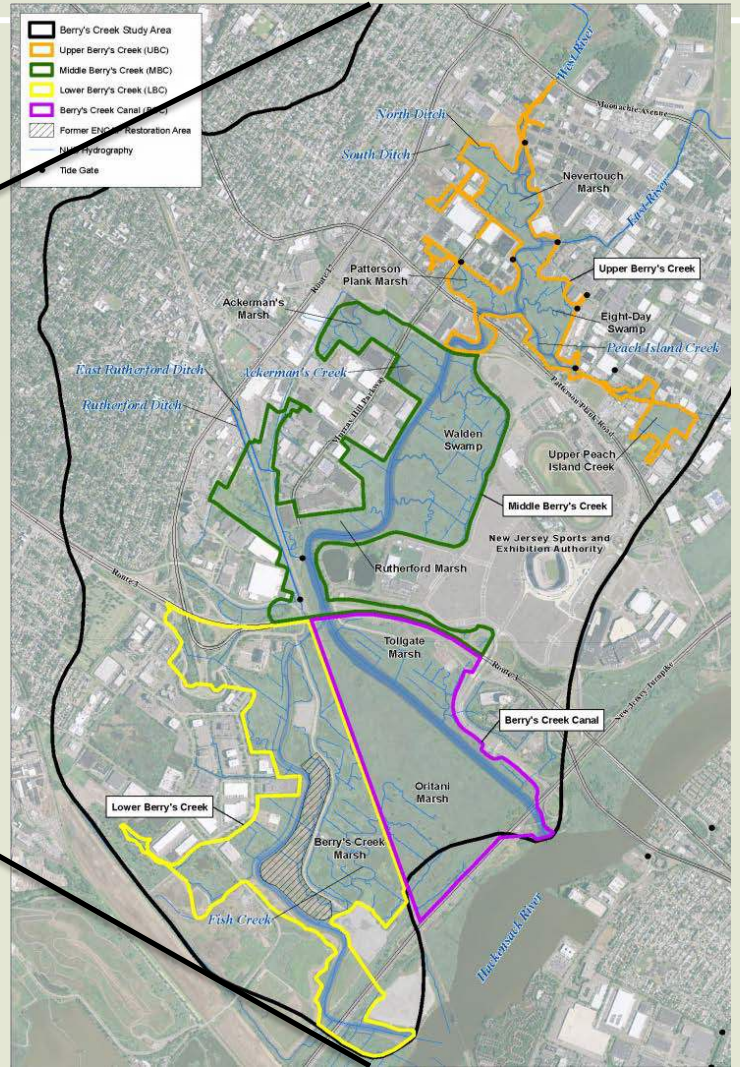
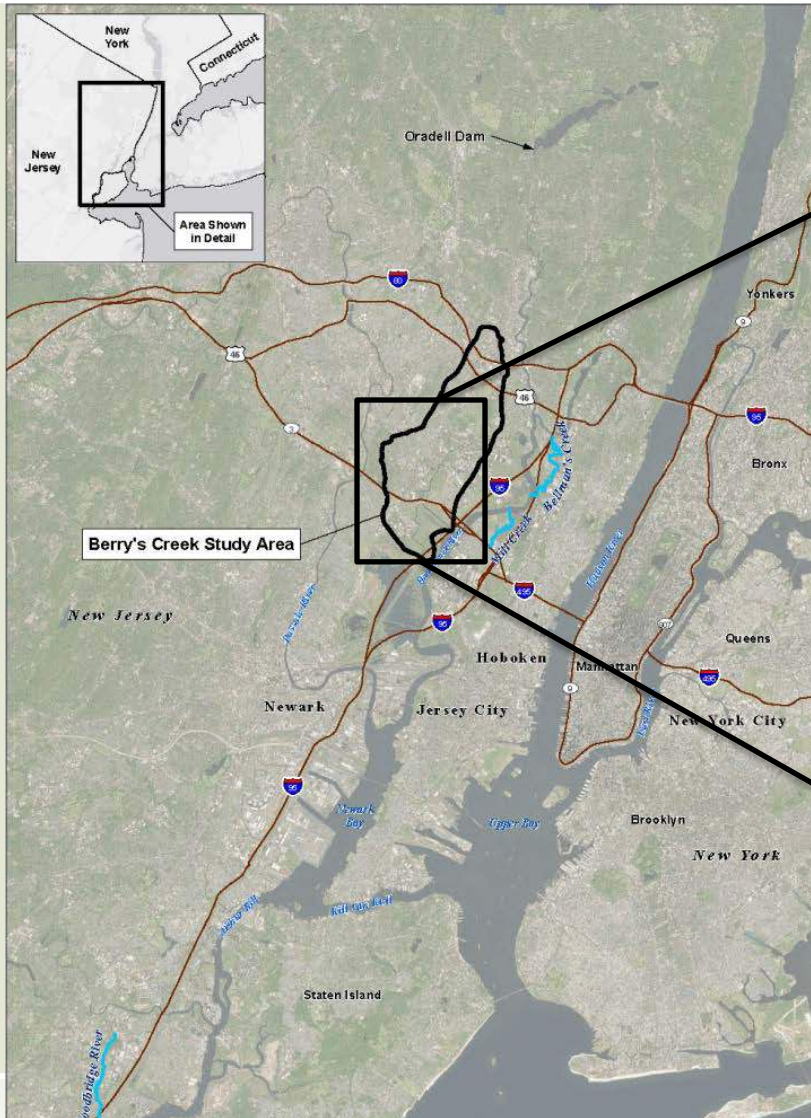
Benefits of Optically-Based Monitoring

- Provides robust understanding of variability in water quality and exposure concentrations
- More powerful data analyses applicable in marine, estuarine, riverine, and lacustrine environments
- High resolution data at low cost

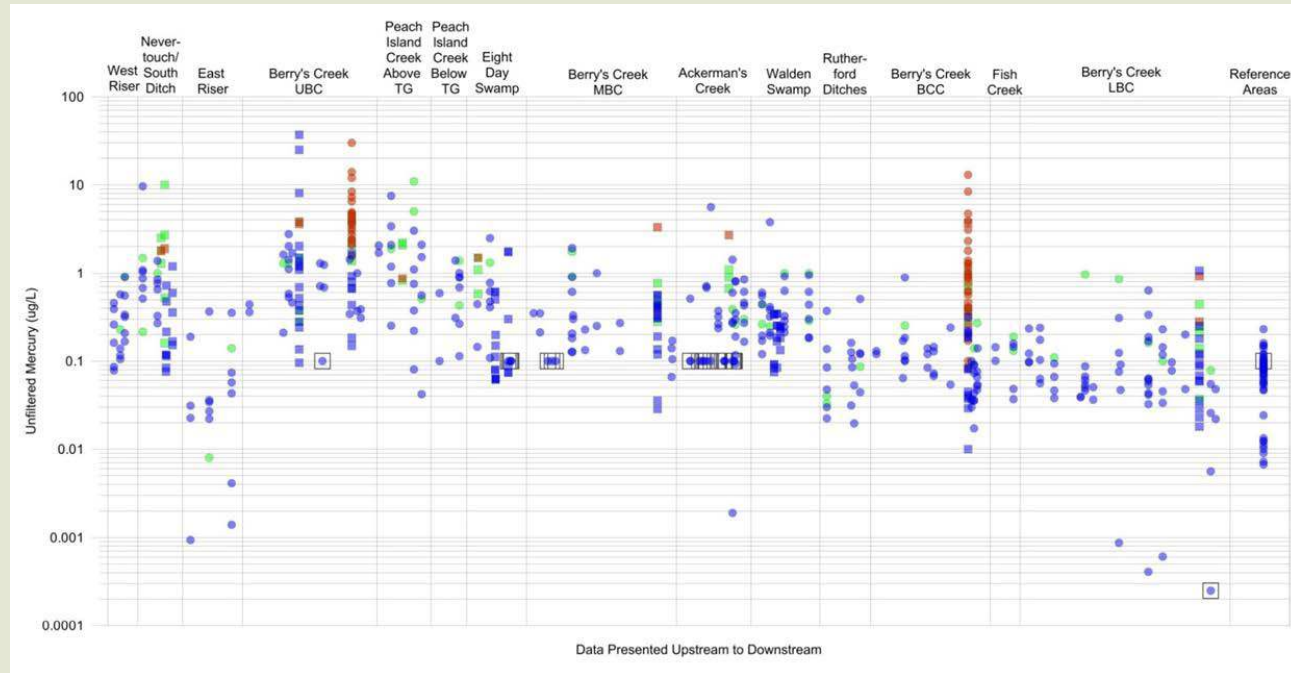


Case Study

Berry's Creek Superfund Site



Water Column COC Concentrations Are Highly Variable



- Ambiguity in conventional surface water data set hinders evaluations
- Need evaluation of the contribution of the 1,000+ acres of tidal marsh to risks

Why Did Integral Recommend Optics?

- Variability is primarily related to:
 - Tidal movement
 - Sediment resuspension/ deposition
 - Flushing during storms
 - Interaction with the marshes

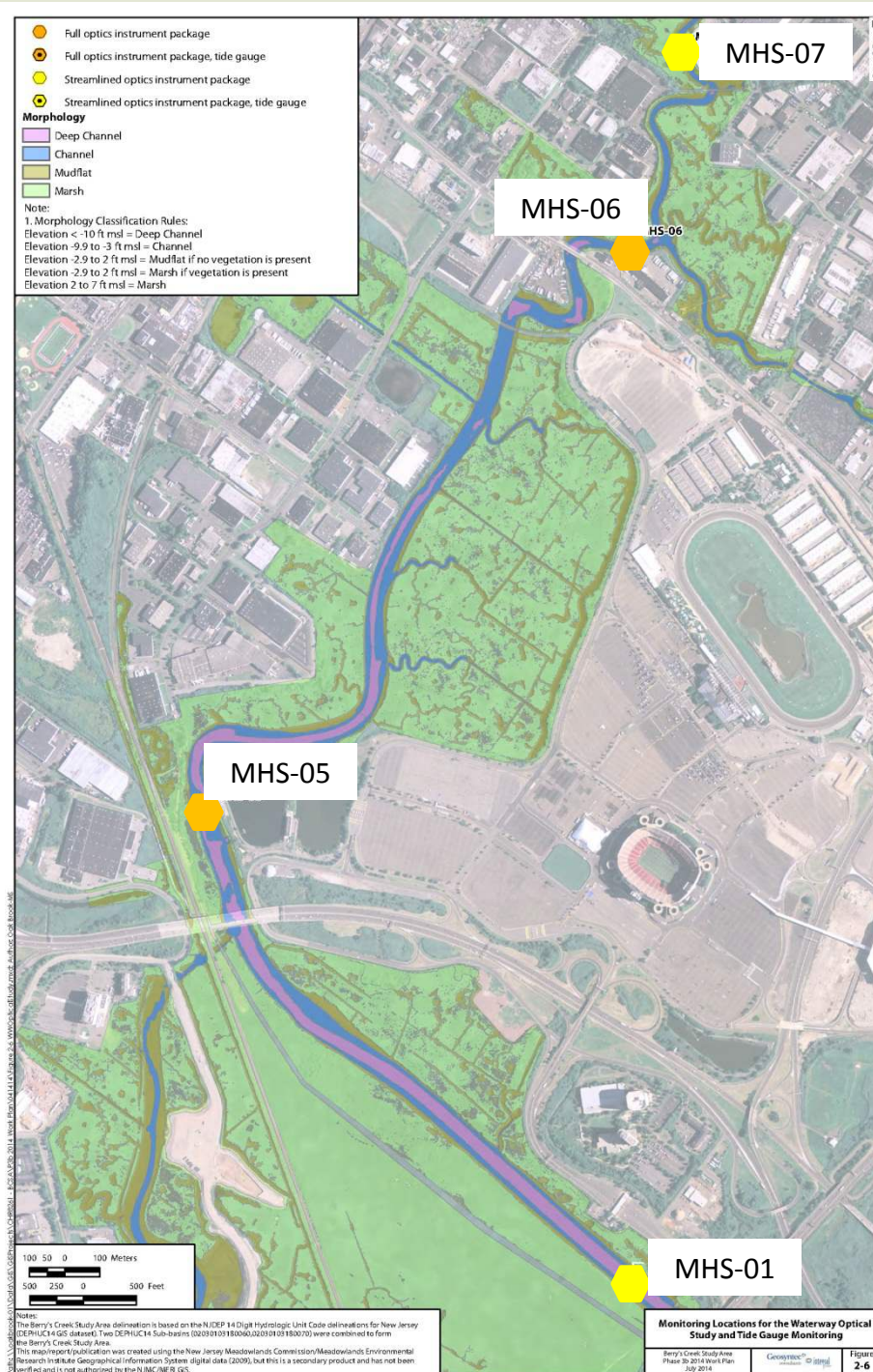


Optical Instrumentation Package



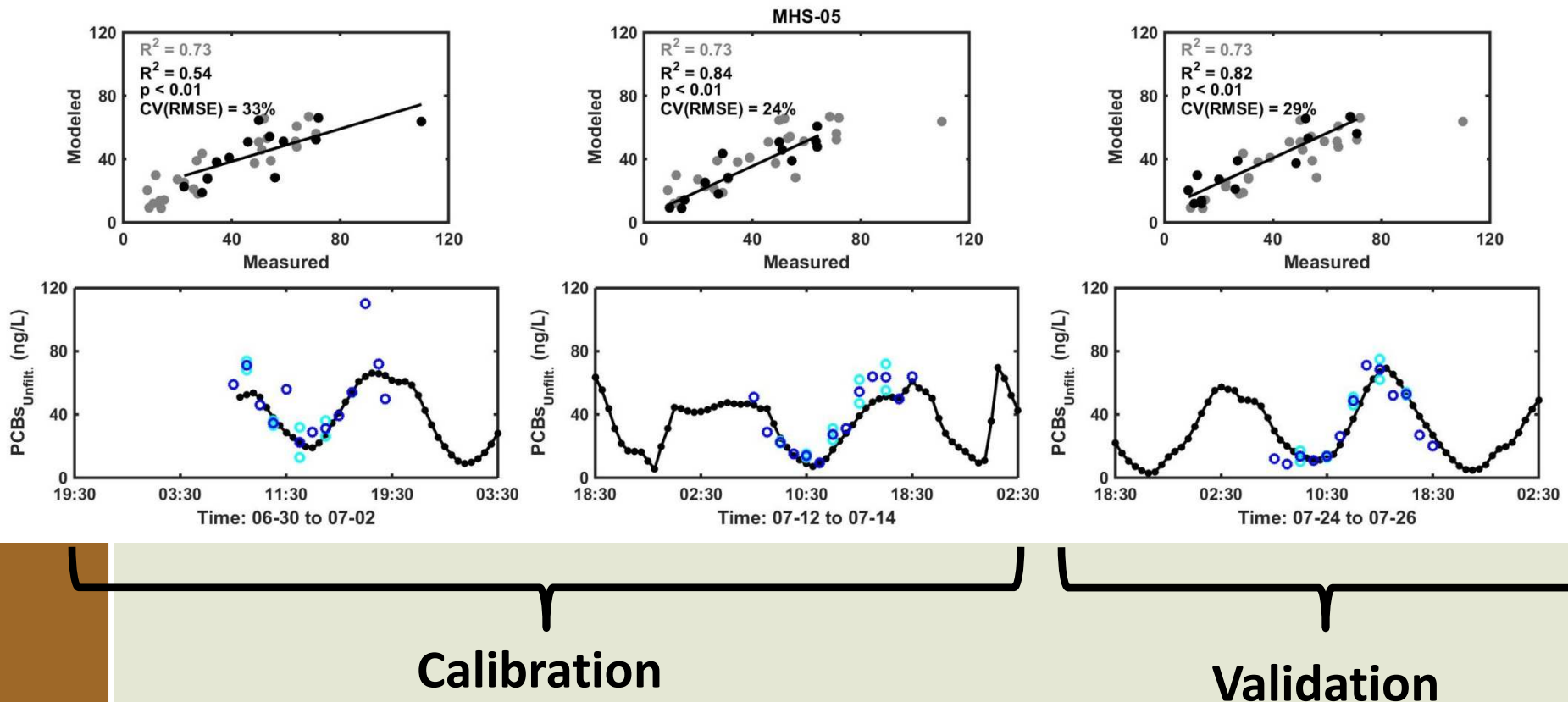
Waterway Study

- Month-long study in July 2014
- Four locations along the primary waterway

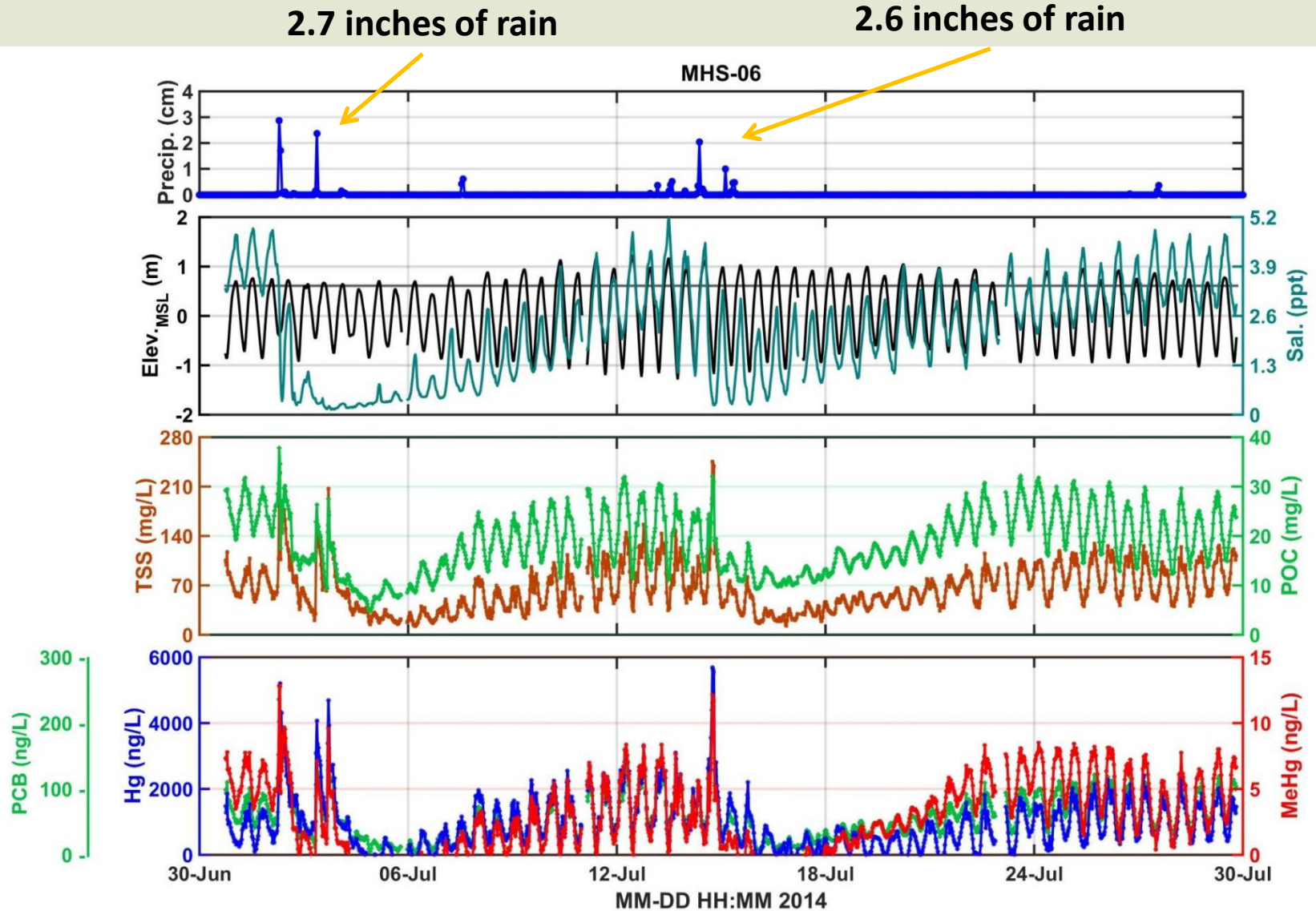


Optical Models Show Good Agreement with Analytical Measurements

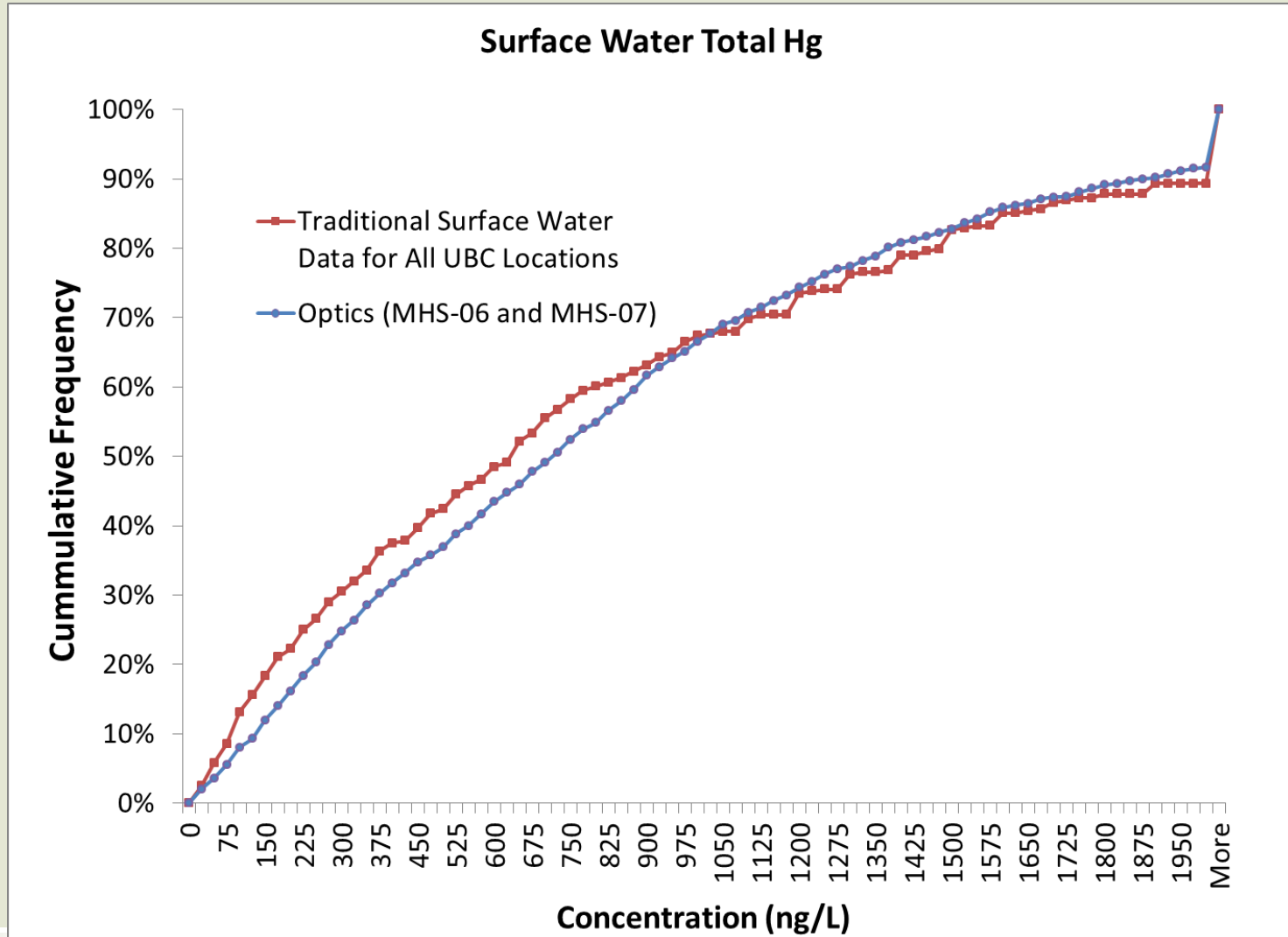
Example Model Calibration Results: MHS-05 PCBs



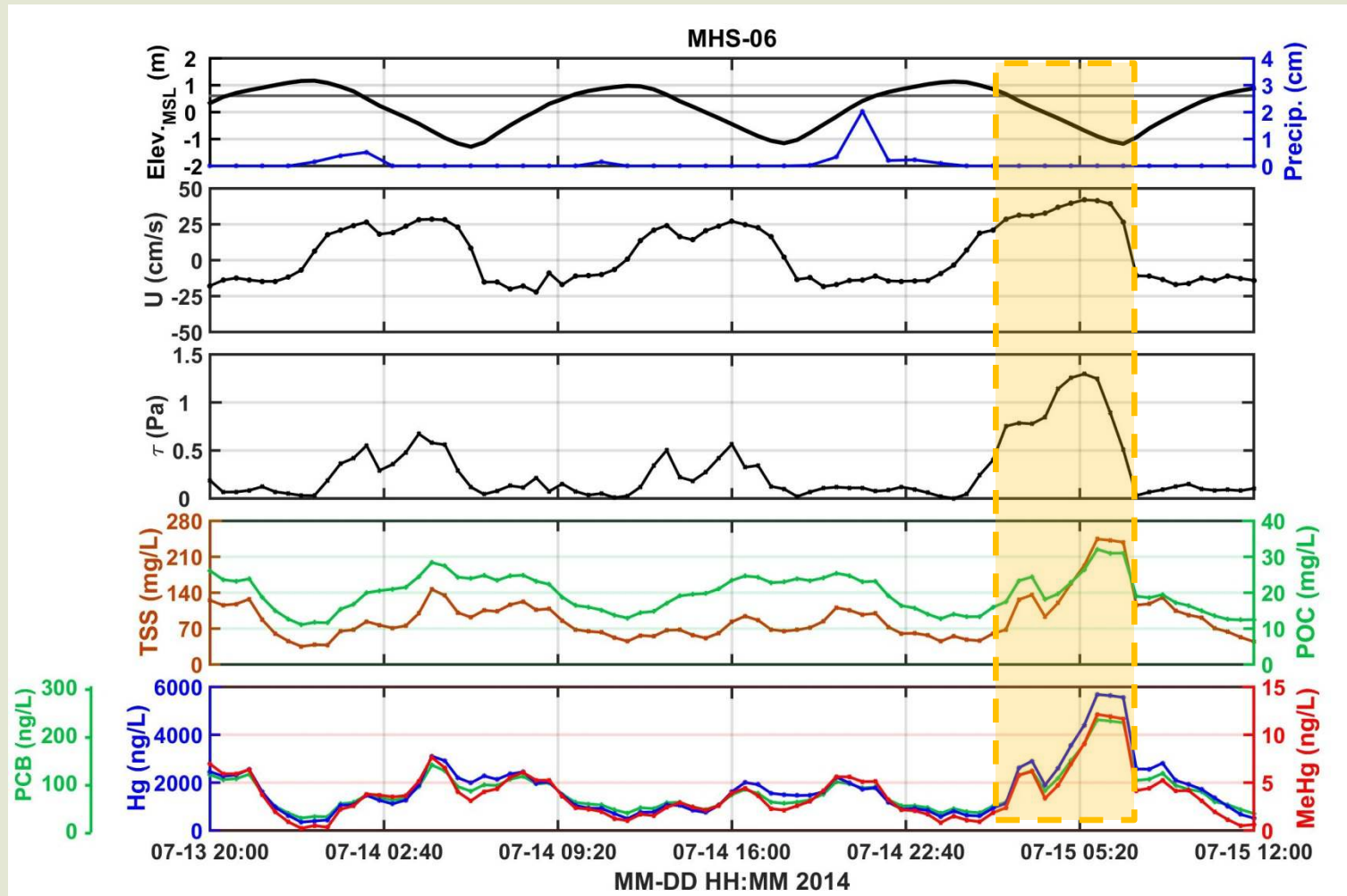
Water Quality Variations in Response to Tidal and Storm Processes



The Single Optical Monitoring Event Captured the Same Range of COC Concentrations as 5 Years of Conventional Sampling



Effects of Storm Flows on Particulate COCs



Optics Study Benefits

- More accurate and thorough characterization at lower cost
- Substantially improved our understanding of ecological exposures

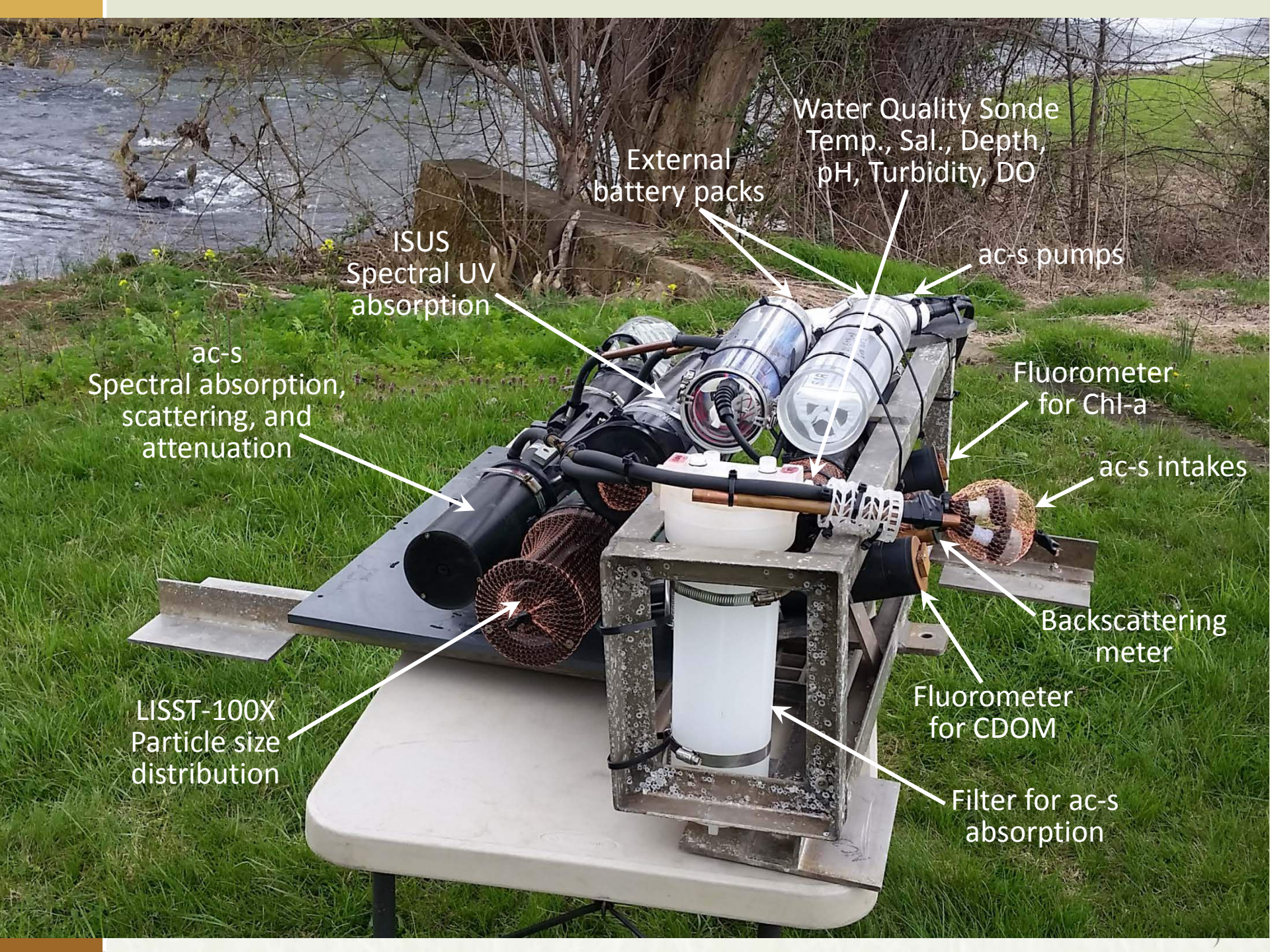


- Demonstrated the primary sources/ mechanisms influencing contaminant concentrations
 - Primarily related to interactions with waterway surface sediments
 - Marshes are a sink for particulate contaminants

South River Pilot Study

- Deployed at RRM 11 (Augusta Forestry Center)
- One to two month
- AECOM sampling for calibration/ validation
 - 6 Baseflow events/ mo.
 - 1 Storm event
 - TSS, POC, DOC, total and dissolved Hg and MeHg





Water Quality Sonde
Temp., Sal., Depth,
pH, Turbidity, DO

External
battery packs

ac-s pumps

ISUS
Spectral UV
absorption

ac-s
Spectral absorption,
scattering, and
attenuation

Fluorometer
for Chl-a

ac-s intakes

Backscattering
meter

Fluorometer
for CDOM

Filter for ac-s
absorption

LISST-100X
Particle size
distribution



Thank You!

Questions?

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