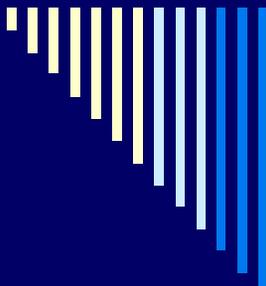


Sensors: Making Monitoring More Useful

Charles S. Spooner

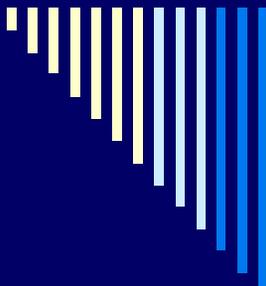
US EPA

May 20, 2008



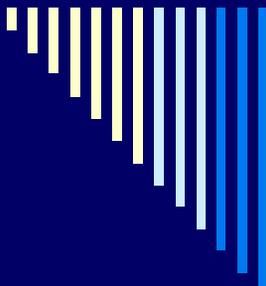
Evolving Needs of Monitoring

- Water issues will become more urgent concerns
 - Climate change will spark a greater interest in context
 - Influence of the weather
 - Influence of control actions
 - Forecast of water quality
 - Society will increasingly want news, not histories
 - Economics will demand accountability for investments
 - Adaptive management will continue to be used in water programs
-



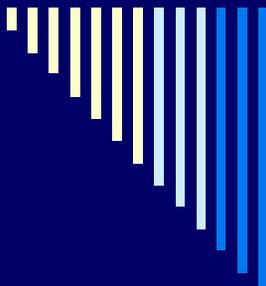
How Can Monitoring Adapt ?

- Data converted to information more quickly
 - Data reported without “normal” delays
 - Data that explains the current status, not some historical summary
 - Data context that is more current, giving it more meaning
 - Information that supports adaptive management
 - More refined questions can be framed and more quickly addressed
 - Data with reduced uncertainty through more frequent measurements
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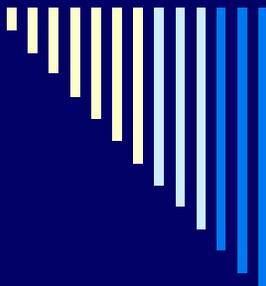
Real-Time Monitoring

- Uses sensors that detect conditions at tight intervals transmitting to data centers and to the Internet
 - Provides actual condition readouts of water
 - Quantity
 - Quality
-



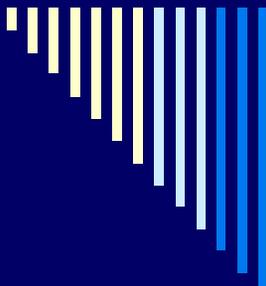
Experience with Real-Time Monitoring

- ❑ USGS has almost 7,000 real-time water streamgaging stations and 1,392 water quality stations
 - ❑ Texas has 50 stations in 11 major watersheds
 - ❑ Local Michigan governments on Lake St. Clair have integrated continuous monitoring with fixed stations
 - ❑ Several efforts relate pollution sources to meteorology and to beach pollution
 - ❑ San Joaquin River Real-time Water Quality Management Program
 - ❑ Mystic River, An EMPACT project with Somerville, Ma. and Tufts University
-



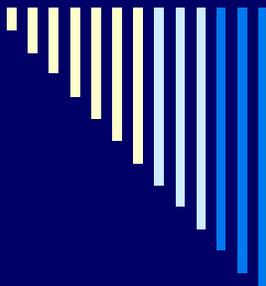
Data With Reduced Uncertainty

- Reduced uncertainty through more frequent measurements
 - Time-series show variations masked by infrequent samples
 - Better criteria / goals
 - Better statistics to reveal changes / trends
 - Better data to calibrate models
-



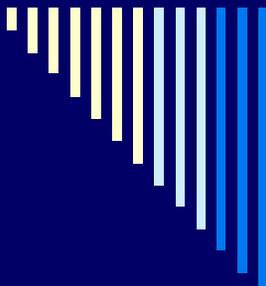
Producing a whole new product

- Actual condition data can provide information on issues of interest, not just data
 - Spills
 - Rainfall upstream
 - Seasonal spikes
 - Involvement with Riverkeepers
 - Oversee the Daily part of TMDLs
 - Identifying where the pollution we “see” today came from
 - Tell where we stand today in reaching our management goals
 - Best Management Practices are more commonly prescribed now.
 - More immediate and more specific the monitored results may prompt greater adherence to these practices
-



Expensive, But Worth It

- Current data is “news,” not “history”
 - Data centers and models can add interpretative value as context for measures of actual conditions
-



Why is This Important to Ambient Monitoring?

- Real-Time Data is Collected Now
 - Sensors are on buoys, at fixed stations and on underwater gliders & moving boats
 - These sensors broadcast conditions to data centers and to the Internet
 - Organizations exist to facilitate sensors:
 - Alliance for Coastal Technology
 - Center for Embedded Network Sensing – UCLA
 - Interstate Technology Regulatory Council (ITRC)
-

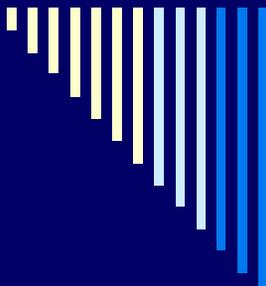


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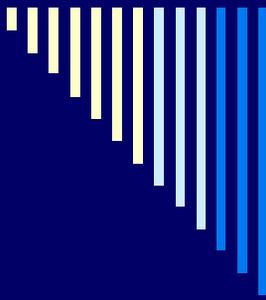
Distributed Sensing Systems for Water Quality Assessment and Management

Authored by: Jeffrey Goldman, Nithya Ramanathan, Richard Ambrose, David A. Caron,
Deborah Estrin, Jason C. Fisher, Robert Gilbert, Mark H. Hansen, Thomas C. Harmon,
Jennifer Jay, William J. Kaiser, Gaurav S. Sukhatme, Yu-Chong Tai



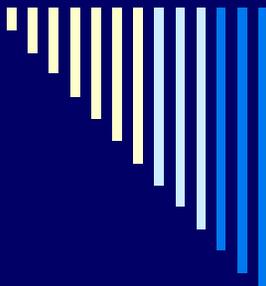
Converting Real –Time Data Into Current Information

- Done now in a few places
 - Texas for salinity controls and NPS diversions, and enforcement
 - Sentinel monitoring of water supplies
 - Beach and shellfish bed warning systems
 - These are mostly first-generation “see it and react” systems
-



The Future of Sensors

- The future will bring
 - Sensors with greater specificity
 - Better station communications
 - Biological sensors and the metrics to use them
 - Smaller sensor packages drawing less power
 - Sensors covering watershed features/needs
 - In-stream flow maintenance
 - Ground water levels -- Precipitation & soil moisture
-



Sensors are Key to the future of monitoring

- Will spark a new set of information products
 - More timely
 - More relevant
 - More expensive
 - But worth it
-