Abstracts

Tuesday, April 29

Session E3: Continuous Monitoring: Innovations in Applications and Instrumentation, Part 2

3:30 – 5:00 pm | Room 261

Results from a National Monitoring Network Lake Michigan Pilot Study: Integrated Surveys of Water Quality and Hydrodynamics in Two Rivermouth Mixing Zones Using an Autonomous Underwater Vehicle

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Abstract
In response to a call for rivermouth research that includes study domains that envelop both the fluvial and lacustrine boundaries of the rivermouth mixing zone, the U.S. Geological Survey in cooperation with the National Monitoring Network for U.S. Coastal Waters and Tributaries launched a pilot project in 2010 to determine the value of integrated synoptic surveys of rivermouths using autonomous vehicle technology. Such surveys can allow researchers collecting continuous point samples at disparate locations to interpret their data and provides modelers with valuable dataset for model calibration and validation.

The pilot project was implemented at two Lake Michigan rivermouths with largely different scales, hydrodynamics, and settings, but employing primarily the same survey methods. The Milwaukee River estuary Area of Concern (AOC) survey included measurements in the lower 2 to 3 miles of the Milwaukee, the Menomonee, and the Kinnickinnick Rivers and inner and outer Milwaukee Harbor. This estuary is situated in downtown Milwaukee, Wisconsin, and is the most populated basin that flows directly into Lake Michigan. In contrast, the Manitowoc rivermouth has a relatively small harbor separating the rivermouth from Lake Michigan and the Manitowoc River watershed is primarily agricultural.

This pilot study using an autonomous underwater vehicle (AUV) paired with a manned survey boat resulted in high spatial and temporal resolution datasets of basic water-quality parameter distributions and hydrodynamics. The AUV performed well in these environments and was found primarily well-suited for harbor and nearshore surveys of three-dimensional water-quality distributions. Both case studies found that use of a manned boat equipped with an ADCP and multiparameter sonde (and optionally a flow-through water-quality sampling system) was the best option for riverine surveys.

Overall, this pilot study was successful and the methods employed in this pilot study should be transferrable to other sites with similar success. The integrated datasets resulting from the AUV and manned survey boat are of high value and present a picture of the mixing and hydrodynamics of these highly dynamic, highly variable rivermouth mixing zones from the relatively well-mixed fluvial environment though the rivermouth to the stratified lacustrine receiving body of Lake Michigan.

Use of High Frequency Water Quality Data to Scale Ecological Processes in Estuaries

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Abstract
Advances in *in situ* instrument technology have increased the feasibility of collecting water quality time series data in aquatic systems. The data derived from such instrument deployments can serve a role in monitoring temporal changes in aquatic systems. However, such datasets are typically available at a few fixed sites in any given

ecosystem, thus limiting the ability to make inferences at larger spatial scales relevant to resource managers. A means of expanding both the spatial and temporal scales is to combine fixed site monitoring datasets with satellite remote sensing data products. A further challenge is to derive ecosystem rates from these data sources, because such information is critical for understanding mechanisms of water quality impairment and, thus, informing resource management decisions. Thus, our overarching goal is to develop tools and models that translate water quality monitoring datasets from in situ sensors, satellite remote sensing, and ecosystem simulation models into integrated measures of ecosystem function or condition. In this study, we developed integrated ecosystem measures (gross production, respiration, and net ecosystem metabolism) in the Pensacola Bay estuary, using a combination of instrument deployments and plankton metabolism experiments. The instruments measured temperature, salinity, dissolved oxygen (DO), depth, chlorophyll fluorescence and CDOM fluorescence, and PAR at 2 depths per site to characterize water column light attenuation. Estimates of ecosystem production and respiration derived from the high frequency DO data using the open water method will be empirically related to other water quality measures to explore the possibility of "scaling up" using measurements from satellite remote sensing and other sources of water quality information, including coupled hydrodynamic-water quality simulation models.

Relations between Continuous Real-Time and Discrete Water-Quality Constituents in the Little Arkansas River, South-Central Kansas, 1995–2011

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Abstract
Water from the Little Arkansas River is used as source water for artificial recharge of the Equus Beds aquifer. The U.S. Geological Survey has operated two continuous real-time water-quality monitoring station since 1995 on the Little Arkansas River. Continuously measured water-quality physical properties include streamflow, specific conductance, pH, water temperature, dissolved oxygen, and turbidity. Discrete water-quality samples were collected during 1995 through 2011 and analyzed for sediment, nutrients, bacteria, atrazine, and other water-quality constituents. Regression models were developed to establish relations between discretely sampled constituent concentrations and continuously measured physical properties to compute concentrations of those constituents of interest that are not easily measured in real time because of limitations in sensor technology and fiscal constraints.

Site-specific regression models were originally published in 2000 and were updated in 2003. This report updates those models using discrete and continuous data collected during January 1995 through December 2011. This report documents the regression models. The real-time computations of water-quality concentrations and loads are available at http://nrtwq.usgs.gov. The water-quality information in this report is important to the city of Wichita because it allows for real-time quantification and characterization of chemicals of concern (including chloride), nutrients, sediment, bacteria, and atrazine transported in the Little Arkansas River. The water-quality information aids in the decision-making of water treatment before artificial recharge.

Sound Science: Sediment Monitoring Using Acoustic Surrogates in the U.S. Geological Survey

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Abstract
Acoustics is a compelling technology that can provide surrogate measurements of suspended-sediment concentration with improved spatial and temporal resolution, after calibration to physically sampled concentrations in rivers and streams. The advantages of acoustic metrics as surrogates of suspended-sediment – compared to today's manually intensive techniques that originated in the 1940s – include greater accuracy and information due to high temporal resolution, large sample volumes, potential for simultaneous velocity

measurements, and environmental robustness. Acoustic surrogates of sediment also hold great potential because of the near-ubiquitous usage of acoustic instruments for streamflow velocity measurement.

The Sediment Acoustic Leadership Team (SALT) was formed in May 2012 by the U.S. Geological Survey (USGS), Office of Surface Water and the Federal Interagency Sedimentation Project. The purpose of the SALT is to provide a focal point for research, methods development, monitoring, and program development in the field of acoustic surrogate metrics of sediment characteristics. This group is made up of experts engaged in sediment-acoustic studies from the USGS and other Federal Agencies. In addition to the activities of the SALT, many USGS scientists are developing sediment-acoustic monitoring sites and programs. The growing number of sites where suspended sediment is being continuously monitored demonstrates the importance and potential of this technology for high resolution sediment data.

This presentation will describe objectives and progress of the SALT to develop interim guidance and software, to develop a sediment-acoustic monitoring network, and to facilitate real-time availability of sediment data estimated by acoustic surrogates. The presentation also will overview selected USGS case studies where acoustic surrogates have been used to monitor suspended sediment characteristics.