

Abstracts

Tuesday, April 29

Session D3: Continuous Monitoring: Innovations in Applications and Instrumentation, Part 1

1:30 – 3:00 pm | Room 261

Real-Time Nitrate Monitoring in Groundwater within a Mixed-Use Watershed in Central Illinois

Patrick Mills, Kelly Warner and Jacob Wikle

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Abstract

Variability of nutrient concentrations in groundwater in response to seasonal or other temporal variability in nutrient applications and precipitation may play an important role in nutrient loading in streams. Collection of groundwater nitrate data at the frequency and duration necessary to best understand the mechanics and significance of the groundwater contribution to stream loads has been hampered by the approaches of typical data collection. Samples must be collected by a manually or automatically operated pump, often followed by laboratory analysis. Among other issues, manual collection can be labor and/ or travel intensive; automated collection can be restricted by limits on number of samples and holding times for analysis. Recent availability of an automated photometric sensor that can provide long-term, near-continuous groundwater nitrate data with real-time broadcast through satellite telemetry should greatly advance groundwater nitrate monitoring capabilities. The sensor determines concentrations by measurement of ultraviolet light adsorption by nitrate.

The capability of the automated sensor in a groundwater application is under evaluation at a 640 acre, agricultural/residential/prairie-wetland parcel at the lower end of a 9,000 acre, predominantly agricultural watershed near Bloomington, Illinois. The timing and stressors driving periodic fluctuations in groundwater nitrate concentrations are not well understood, nor the relation of these fluctuations to the variability of nitrate loads in the nearby streams. The largest nitrate loads in the streams occur in conjunction with larger precipitation events, particularly when near the time of field nutrient applications. The automated sensor has initially been installed in a site well that is located between the newly establishing residential neighborhood and the stream; subsequent installation is planned at a location downgradient of a field cultivated in row crops. Along with assessment of the performance and maintenance requirements of the sensor, it is anticipated that its use will prove valuable to better understanding of nitrating loading in the watershed.

Using Continuous Real-Time Water-Quality Data to Estimate Organic Carbon Export from an Urban Stream

Jami Goldman, Stewart Rounds, Mackenzie Keith and Steven Sobieszcyk

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Abstract

Organic matter (OM) is a critical component of food webs and biogeochemical cycles, and an important factor in the dissolved-oxygen budget of a stream, as oxygen is consumed when OM decomposes. Identifying and quantifying the sources and transport of OM is essential for crafting effective management strategies to protect or restore stream water quality. Sources of OM to Fanno Creek, an urban stream near Portland, OR, were estimated and compared to instream loads of organic carbon to better understand the contributions, variability, and characteristics of those sources.

Continuous measurements of fluorescent dissolved organic matter (FDOM), light scattering (turbidity), and streamflow were used to estimate instream concentrations and loads of organic carbon near the mouth of Fanno

Creek. Concentrations of dissolved organic carbon (DOC) were estimated from regressions of DOC and FDOM data. Particulate organic carbon (POC) concentrations were estimated from a multiple linear regression of POC data against FDOM and turbidity data. Regressions were linear and predicted DOC and total organic carbon (DOC + POC) concentrations with median errors of +/- 10 and 15 percent, respectively. Loads were computed by multiplying carbon concentrations by measured streamflows.

Roughly 340,000 kg of organic carbon was exported during March 2012 to March 2013. Isotope and fluorescence data indicate that Fanno Creek OM was primarily of terrestrial origin. The export load was consistent with a dominant OM source from riparian litterfall and a minor contribution from bank erosion. Most of the OM in Fanno Creek was dissolved (72 percent) and present year-round at concentrations exceeding 3-4 milligrams carbon per liter. POC typically was mobilized and transported only episodically by higher-flow conditions. The first high flows of the rainy season in autumn produced the highest concentrations of OM, and the resulting load of mobilized and decomposing OM expressed a significant oxygen demand immediately downstream. Continued monitoring of OM characteristics and their rate of export will be useful as watershed managers continue restoration activities, enhance stormwater management, and modify riparian plantings to decrease OM loadings.

Characterization of Water-Quality Gradients in an Urban Midwestern Stream Using a Floating Sensor Platform Developed for Lagrangian Data Collection

Guy Foster, Jennifer Graham and Mandy Stone

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Abstract

Indian Creek, in Johnson County, Kansas, is an urban stream that receives discharge from two wastewater treatment facilities. To more fully characterize nutrient dynamics, fate, and transport, high-resolution water-quality data (including specific conductance, pH, temperature, dissolved oxygen, turbidity, and nitrate) were collected using a Lagrangian sampling strategy. A floating sensor platform equipped with water quality sensors coupled with a global positioning system was deployed from upstream to downstream maintaining equal velocity with streamflow by allowing the unit to travel with the current. The onboard sensors collected data at 30 second intervals to provide high resolution spatiotemporal data. These data were then compiled and integrated using geographic information systems to provide a visual means to assess longitudinal gradients in water-quality data. Data collected using this approach was used to characterize nutrient dynamics, fate, and transport by coupling the data with constituent models developed over two years of recent continuous monitoring on Indian Creek. Understanding the dynamics, fate, and transport of nitrate in Indian Creek will help document the efficacy of wastewater treatment processes and the development of effective nutrient reduction strategies, watershed management plans, and best management practices. Future applications of this approach could include a wide range of water bodies, including both streams and lakes.

The Application and Utility of Continuous Instream Monitoring as Part of a Large River Assessment of the Susquehanna River, Pennsylvania

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Abstract

The Pennsylvania Continuous Instream Monitoring (CIM) program was developed and solidified over the past four years in order to better characterize pre-drilling water quality in the Marcellus shale gas region of Pennsylvania. However, the utility of this CIM methodology was recently expanded, due to the decline of what had been a world-class smallmouth bass (SMB) fishery in the Susquehanna River – Pennsylvania's larger river basin. An existing network of fixed station data recorders (sondes) in the large and wide Susquehanna River cannot accurately characterize localized SMB habitat water quality. To meet this challenge, 30 sondes were deployed in several sections and tributaries of the Susquehanna River and other out-of-basin major river systems (to serve as controls).

These sondes were intended to characterize the summer critical season where water quality parameters such as temperature, DO, and pH were most likely to exceed Pennsylvania's water quality criteria. The placement and sampling period of these sondes were not intended to give an all-encompassing assessment of the river, but rather to better understanding of these water quality influences on local habitats and from major tributary confluences that create long distance, non-mixing flow channels within the Susquehanna River. This style of sonde deployment allowed for water source tracking when critical water quality conditions were observed. Additionally, the assessment utility of continuous data required a new perspective on the interpretation of water quality criteria. Here we discuss the results, challenges, and lessons learned over two years of this river project.