Abstracts

Thursday, May 1

Session L6: Spatial and Temporal Approaches for Monitoring

1:30 – 3:00 pm | Room 232

USGS Tributary Monitoring Network to Support Great Lakes Restoration Efforts

Dan Sullivan
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Abstract
In support of Great Lakes Restoration Initiative (GLRI) goals, the USGS is collecting inorganic and organic contaminant data from tributaries and nearshore embayments of the Great Lakes. These data are providing baseline information to assess progress towards restoration goals and to identify new contaminant threats. A total of fifty-nine tributary sites are included in the National Monitoring Network for Coastal Waters (NMN) design for the Great Lakes basin; of these, 30 are being monitored on an ongoing basis.

The 30 Great Lakes NMN sites are equipped with automatic sampling systems and multi-parameter sondes. The automatic samplers collect water-quality samples during storm events to supplement monthly manual sampling for estimating loading of nutrients, sediment, and chloride. The sondes provide continuous monitoring of specific conductance, pH, temperature, turbidity, and dissolved oxygen. Regression models to predict concentrations of analytes not directly measured by the mulit-parameter sondes have been developed. Using a combination of the continuous data and discrete constituent measurements, the regression models allow for a more cost-effective long-term water-quality monitoring approach for Great Lakes tributaries.

Long-Duration High-Frequency Monitoring of Nutrients and Sediments in an Agricultural Watershed

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Abstract
Land use and land management have major impacts on water quality, and watershed management programs focus on promoting good practices. However, monitoring water quality responses to land use and land management is costly and time-consuming, and it can be difficult to demonstrate the effects of land management efforts.

In the early 1990s a watershed management plan was put in place in the Upper Four Mile Creek watershed in southwest Ohio. The 260 km2 watershed is predominantly agricultural (~90% cropland), and nutrients and sediment in agricultural runoff significantly impact Acton Lake, an important recreational resource within Hueston Woods State Park. In the early 1990s ~15% of cropland in the watershed was in conservation tillage, but by 2000 it had reached ~70%. Since 1994 we have monitored stream flow, ammonium (NH4), nitrate (NO3), soluble reactive phosphorus (SRP), and suspended sediment (SS) concentrations on three streams tributary to Acton Lake. The streams range in drainage area from 12 to 129 km2, and together represent 85% of the area tributary to the lake. Our sampling is flow-dependent, generating a daily record of concentration and load for NH4, NO3, SRP and SS, and by extrapolation total dissolved and particulate N and P for each stream.

Despite the high resolution of the data, noise obscures long-term trends. Nonetheless, by 2006 discharge-standardized concentrations of NH4, SRP, and SS had decreased 40-60%, while trends in NO3 concentrations were small or negligible. Recent change point analyses of the 19-year record indicate a complex history with several instances of trend reversals, *e.g.*, concentrations of some constituents declined for some years and then increased. These changes are likely caused by a combination of weather and land management effects.

Using Critical Timing to Couple Continuous Water Quality Monitoring Data and Proposed Nitrate Reduction Strategies

Jessica Garrett
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Abstract
Nitrate runoff contributes to loss of agricultural productivity, degradation of local streams, and hypoxia in the Gulf of Mexico. The critical event and seasonal timing vary for environmental concerns for nitrate concentrations and transport for relevant spatial scales – from fields, to local streams, and to the Gulf. Systems of watershed management strategies are commonly targeted in small basins for the best chance of measurable improvements. The effective timing of some strategies and implementation scale do not always match the critical timing or scale of the environmental concern. Monitoring nitrate loads at times and scales relevant to the environmental issues or watershed management strategies is challenging due to flashy streamflow and complex interactions between streamflow and concentrations.

Continuous nitrate and streamflow monitoring data, including optical nitrate sensors, are assessed for concentrations and loads during critical timing and at several sites for a broad range of scales. Critical timing for environmental issues include peak nitrate concentrations for drinking water supplies, cumulative annual loads, spring loads contributing to Gulf hypoxia, and periods of peak crop nutrient-uptake demand. Additionally, continuous nitrate and streamflow data are assessed relative to effective timing and implementation scales for several nutrient management strategies.

For example, nitrate concentrations greater than the 10 mg/l maximum contaminant level commonly occur in the Midwest during spring and early summer high-streamflow events. A restored floodplain connection (decommissioned levee) near the mouth of the Maquoketa River in Iowa allows partial flow diversion into the floodplain. For storm events in 2013 that generated river levels high enough to enter the floodplain, three of four events had stream nitrate concentrations in one major tributary with continuous nitrate monitoring greater than 10 mg/L. Management strategies, such as this restored floodplain connection or cover crops, potentially reduce stream nitrate transport during high streamflow, when a large part of the annual load is transported downstream. Conversely, reduction strategies which rely on residence time and biological removal of nitrate, such as bioreactors and wetlands, are not as effective during storm events in spring and early summer, but may reduce baseflow, warm-season nitrate contributions more efficiently.

Dissolved Organic Matter as an Indicator of Watershed Processes

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Abstract

Assessment of DOM concentration, composition, flux, and yield provides a basis for understanding watershed processes and biogeochemistry of rivers and streams. Examples demonstrating of the interpretational utility provided by deriving DOM metrics will be presented based on multi-year studies designed to assess seasonal and spatial variations in DOM quantity and quality for 18 large North American rivers. DOM concentration and composition varied greatly between sites and seasonally at a given site. Generally, DOM optical parameters correlated strongly with DOM concentration and aquatic humic substances content. These relationships vary between rivers and were weak for rivers draining arid regions and those heavily influenced by impoundments. Similar trends were not as robust for DO14C, which better reflected irrigation, ground water and waste-water contributions to the DOM pools. There was a significant positive correlation between basin wetland-cover and average DOM concentrations (R2 = 0.78; p<0.0001) and composition (SUVA254; R2=0.91; p<0.0001) demonstrating the importance of wetlands in the export of terrestrially-derived DOM in rivers. While individual watershed characteristics controlled DOM concentrations and composition, overall discharge dominated the flux of DOM to coastal waters.