Abstracts

Wednesday, April 30

Session G5: Quantifying the Source and Fate of Nutrients

10:00 – 11:30 am | Room 233

Evaluation of Nitrogen Sources and Transport Processes in the Smith Creek Watershed, an Agricultural Basin in Virginia

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Abstract
The Smith Creek watershed is an agricultural basin in the Shenandoah Valley of Virginia that is undergoing considerable implementation of agricultural conservation practices. To better inform decision making associated with the implementation of these conservation practices, an intensive water quality monitoring effort was initiated to determine the nitrogen sources and transport processes within the Smith Creek watershed. Results will be presented from intensive water-quality monitoring at the basin outlet which includes collection of monthly and stormflow water-quality samples, continuous monitoring of field parameters (turbidity, specific conductance, water temperature, pH, and dissolved oxygen), as well as continuous monitoring of nitrate concentrations. Additionally, spatial patterns in nitrogen concentrations were monitored throughout the watershed to better understand which areas contributed the highest nitrogen concentrations and loads; these spatial patterns seem largely controlled by basin geology and land use. Environmental tracer results (including geochemistry, nitrate isotopes, and emerging contaminants) have been used to identify nitrogen sources within the watershed. By understanding nitrogen transport processes and sources, water-resource managers can better target the implementation of best-management practices and more effectively improve water-quality conditions in the Smith Creek watershed.

Development of Statistical Models to Quantify Sediment and Phosphorus Loads in Small, Rural Watersheds

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Abstract
In small, rural watersheds in western Illinois, the overwhelming majority of sediment and phosphorus loads are delivered during storm flow events. Due to the short duration of the storms, the collection and analysis of data during these runoff events must be done on a sub-daily time step. To investigate the role of individual runoff events on loads, a load calculation method must be selected that allows for investigating small time scales.

Statistical models with residuals-based error correction (*i.e.*, the composite method) have become an increasingly popular technique for load calculations. This study is an application of error-corrected regression models to compute continuous records of suspended sediment concentration and total phosphorus concentration. Due to the small drainage areas of the studied streams, all regression models were developed and applied using a 15-minute time-step. Four methods of constructing continuous concentration records were compared, and the best method was selected in order to compute sediment and phosphorus loads for a 10-year period of study. Comparison of accuracies of the four estimation techniques will be presented for both suspended sediment and total phosphorus load calculations.

During the ten-year study period, 5% of the record accounted for approximately 50% of the flow, 91% of the total phosphorus load and more than 96% of the sediment load. On average, the 1-day maximum accounted for 10% of annual flow and more than 30% of annual sediment and phosphorus load.

Lessons learned from this intensive monitoring effort will be presented, along with recommendations for monitoring design and load calculation techniques for small, rural watersheds.

Connecting the Dots – Continuous Nitrate, Phosphorus, and Sediment Loads in the Illinois River

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Abstract
The Illinois River basin is an urban and agricultural watershed, including the Chicago metropolitan area and some of the most productive corn and soybean acreage in the nation. The Illinois River contributes approximately one-half of the total flow and the majority of nitrogen and phosphorus load from Illinois to the Mississippi River. There is an extensive historical record of streamflow (since 1939), suspended-sediment (since 1980), and water-quality (since 1974) data for the downstream reach of the Illinois River at Valley City, Illinois, in Scott County. The U.S. Geological Survey has installed a suite of instruments at the Illinois River at Florence station (station 05586300), which is 5.2 river miles downstream from the Valley City station, in May 2011 to measure flow and collect continuous real-time data for stream velocity, nitrate, phosphate, temperature, specific conductance, pH, dissolved oxygen, and turbidity. The continuous data are compared to ongoing discrete water-quality and sediment data collection funded by several agencies, including the USGS and IEPA. The continuous data record provides information that allows for a better understanding and more accurate calculation of baseline loadings, seasonal loadings, and storm-event loadings of nutrients and sediment. Continuous data is also being collected for sediment surrogate evaluation using three different frequencies of acoustic velocity meters and a Laser *In Situ* Scattering and Transmissometry (LISST) during selected time periods. The evaluation of different real-time water-quality and sediment constituents and surrogates, as well as, loads calculation at the Illinois River at Florence provides information required to assess the degree of success and the downstream effects of best-management practices, regulatory changes, and source reductions of nutrients and sediment in the Illinois River basin.

Nitrogen in Minnesota Rivers: Conditions, Trends, Sources, and Reductions

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Abstract
Minnesota recently completed a comprehensive report on river nitrogen conditions, trends, sources, and options for reducing loads. River and stream monitoring results from over 700 sites (50,000 water samples) were analyzed to characterize recent surface water nitrogen conditions across Minnesota. The findings, when combined with other river monitoring and modeling results, provide a clear picture of how nitrogen concentrations and loads vary in Minnesota. Nitrogen concentrations and loads are high throughout most of southern Minnesota (exceeding 5 mg/l) and are low in northern Minnesota. Fifteen southern Minnesota watersheds contribute 74% of the load to the Mississippi River, with the highest loads coming from the Minnesota River Basin in south-central Minnesota.

Statistical trend analyses at 51 river sites show how flow-adjusted nitrate concentrations have changed over time between 1976 and 2010. Mississippi River nitrate concentrations have more than doubled since the mid-1970s and are still increasing. The Minnesota River nitrate levels remain very high, but show some recent signs of stability or improvement.

Nitrogen reaches rivers from a variety of sources. The largest source is cropland, contributing an estimated 73% of the statewide load during an average precipitation year. The largest pathway to surface waters is row-crop tile drainage, followed by groundwater baseflow that originates under cropland. Cropland runoff contributes much less nitrate to surface waters compared to the subsurface pathways. Wastewater point sources of nitrogen, dominated by municipal wastewater, contribute an estimated 9% of the load. The estimated sources correlated reasonably well with river monitoring results.

Progress can be made to reduce nitrate through widespread adoption of a series of best management practices, including optimal fertilizer rates and timing, tile drainage management and treatment, and strategic use of perennial vegetation. Minnesota state planning authorities have been using a spreadsheet tool (NBMP) that enables watershed planners to evaluate expected nitrogen reductions to rivers when different combinations of cropland BMPs and BMP adoption rates are considered.