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Welcome to the USGS NAWQA Program Highlights, April - September 2011

Highlights are from the USGS [National Water-Quality Assessment Program](#) (NAWQA), which has assessed the physical, chemical and biological characteristics of streams, rivers, and groundwater across the Nation since 1991.

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In this quarter's highlights:

Ecology

• **Indices of biological integrity used to assess impairment related to land use disturbances on benthic algal communities in U.S. streams and rivers** – Access the USGS [Open-File Report 2011-1126](#) online. Learn about other NAWQA [ecological national synthesis studies](#). For more information on the study, contact [Daren Carlisle](#).

Traditional and alternate procedures for developing and applying indices of biological integrity on a national scale were evaluated for five regions of the United States to assess the overall biological health of algal communities at 1,071 NAWQA sampling sites across diverse land-use settings. The indices were developed by evaluating whether 124 alternative metrics of algal communities were able to discriminate between streams in disturbed and undisturbed watersheds. The assessment of algal communities in urban and agricultural land-use settings indicated increased stress to ecological health when compared to communities in other land-use settings.

• **Regional patterns of invertebrate and algal responses to urbanization across the USA** – Access the featured article in [September 2011](#) issue of the Journal of the North American Benthological Society. Learn about other NAWQA [effects of urbanization on stream ecosystem studies](#). For more information, contact [Thomas Cuffney](#).

Multilevel hierarchical regression was used to examine regional patterns in the responses of benthic macroinvertebrates and algae to urbanization across 9 metropolitan areas of the conterminous USA. Regional differences in the type of land cover (agriculture or forest) being converted to urban and climatic factors (precipitation and air temperature) accounted for the differences in the response of macroinvertebrates to urbanization. Regional differences in climate and antecedent agriculture also accounted for differences in the responses of salt-tolerant diatoms, but differences in the responses of other diatom metrics were best explained by regional differences in soils (clay content). The effects of climate and land cover on responses to urbanization provide strong evidence that monitoring, mitigation, and restoration efforts must be tailored for specific regions and that attainment goals (background conditions) may not be possible in regions with high levels of prior disturbance (agricultural development).

Groundwater

• **Modeling the potential impact of seasonal and inactive multi-aquifer wells on contaminant movement to public water-supply wells** – Access the article in the [June 2011](#) issue of the Journal of American Water Resources Association. Learn about other NAWQA [transport of contaminants to supply well studies](#). For more information on the study, contact [Sandra Eberts](#).

Wells screened across multiple aquifers can provide pathways for the movement of surprisingly large volumes of groundwater to confined aquifers used for public water supply. A single inactive multi-aquifer well can contribute nearly 10% of total public water supply well flow over a wide range of pumping rates. This leakage can occur even when the multi-aquifer well is more than a kilometer from the public water supply well. The contribution from multi-aquifer wells may be greater under conditions where seasonal pumping (e.g., irrigation) creates large, widespread downward hydraulic gradients between aquifers.

Under those conditions, water can continue to leak down a multi-aquifer well from an unconfined aquifer to a confined aquifer even when those multi-aquifer wells are actively pumped. An important implication is that, if

an unconfined aquifer is contaminated, multi-aquifer wells can increase the vulnerability of a confined-aquifer public water supply well.

• **A comparison of recharge rates in aquifers** – Access the article in the [Vol. 11, 2011](#) issue of the Hydrogeology Journal. For more information on the study, contact [Pete McMahon](#).

An overview is presented of existing groundwater-age data and their implications for assessing rates and timescales of recharge in selected unconfined aquifer systems of the United States. Apparent age distributions in aquifers determined from chlorofluorocarbon, sulfur hexafluoride, tritium/helium-3, and radiocarbon measurements from 565 wells in 45 networks were used to calculate groundwater recharge rates. Recharge rates ranged from <10 to 1,200mm/yr in selected aquifers. Age-based recharge estimates can provide useful insights into spatial and temporal variability in recharge at a national scale and factors controlling that variability. Local age-based recharge estimates provide empirical data and process information that are needed for testing and improving more spatially complete model-based methods.

• **Factors affecting groundwater quality in the Valley and Ridge aquifers of eastern United States** – Access the USGS [Scientific Investigations Report 2011-5115](#) online. Learn about other NAWQA studies in the [Piedmont and Valley and Ridge](#). For more information on the study, contact [Bruce Lindsey](#)

Ground-water quality conditions in 230 wells and 35 springs in the Valley and Ridge Physiographic Province indicated that bedrock type and land use were dominant factors influencing groundwater quality. Wells and springs in carbonate-rock aquifers in the Valley and Ridge are much more likely to have anthropogenic contaminants than wells in siliciclastic-rock aquifers because of a combination of aquifer susceptibility and the land-use practices preferentially located on the land overlying these aquifers. The most powerful single predictor of elevated groundwater contaminant levels in the Valley and Ridge aquifers is rock type, as shown by higher likelihoods of elevated nutrients, pesticides, VOCs, and bacteria counts in carbonate-rock aquifers and of elevated radon and dissolved mineral concentrations in siliciclastic-rock aquifers.

• **Trace elements and radon in groundwater across the United States** – Access the USGS [Scientific Investigations Report 2011-5059](#) online. Learn about other NAWQA [trace element studies](#). For more information on the study, contact [Joseph Ayotte](#).

About 20% of untreated water samples from over 5,000 public, private, and monitoring wells across the nation contain concentrations of at least one trace element, such as arsenic, manganese, and uranium, at levels of potential health concern. Long-term exposure to arsenic can lead to several types of cancer, and high levels of uranium can cause kidney disease. In doses similar to some of those found in this study, manganese can adversely affect child intellectual function and, in large doses, acts as a neurotoxin, causing symptoms similar to those experienced by sufferers of Parkinson's disease. Most trace elements, including arsenic, manganese, and uranium, get into the water through the natural process of rock weathering. In public wells these contaminants are regulated by the U.S. Environmental Protection Agency and are removed from the water before people drink it. However, trace elements could be present in water from private wells at levels that are considered to pose a risk to human health, because they aren't subject to regulations.

• **Subsurface transport of orthophosphate in five agricultural watersheds, USA** – Access the featured article in the [October 2011](#) issue of the Journal of Hydrology. For more information, contact [Josphe Domagalski](#).

Phosphorus transport in groundwater was assessed at five agricultural watersheds in California, Indiana, Nebraska, Maryland, and Washington. Under conditions where phosphorus is either not entirely taken up by plant tissue or where soil chemistry does not favor either precipitation or sorption, sub-surface transport can result in elevated concentrations in groundwater or loadings to receiving streams. Iron oxides had an effect on phosphorus movement and concentrations at all locations, and groundwater chemistry, especially pH, exerted a major control on the amount of phosphorus adsorbed.

- **Simulation of decay of atrazine and metabolites in adapted and nonadapted soils** – Access the featured article in the [June 2011](#) issue of the Environmental Toxicology and Chemistry journal. For more information, contact [Richard Webb](#).

Decay of a common herbicide, atrazine, and its metabolites observed in unsaturated soils adapted to previous atrazine applications and in soils with no history of atrazine applications was simulated using a branched serial first-order decay model. Results from application of the model indicated that atrazine and its 3 primary metabolites are less persistent in adapted soils than in nonadapted soils and that hydroxyatrazine was the dominant primary metabolite in most of the soils tested. These can reduce the uncertainty in predicting the fate and transport of pesticides and their metabolites and thus support improved agricultural management schemes for reducing threats to the environment.

Streams

- **Organic compounds assessed in Chattahoochee River water used for public supply near Atlanta, Georgia, 2004-05** – Access the USGS [Fact Sheet 201-3062](#) online. Learn about other NAWQA [source water-quality assessments](#). For more information on the study, contact [Brian Hughes](#).

Thirty-three of 266 organic compounds were commonly detected in source water and 27 were commonly detected in finished water from the Chattahoochee River, which is the main water-supply source for the Atlanta metropolitan area. Eighteen of 33 organic compounds in source water also were commonly detected in finished water and often at similar low-level concentrations. Detected compounds included 11 pesticides and degradates and 4 personal care and domestic-use products. Many of the compounds detected most commonly in water from the Chattahoochee River were among the most commonly detected in ambient stream water and groundwater across the Nation.

- **Environmental factors that influence the location of crop agriculture in the conterminous United States** – Access the USGS [Scientific Investigations Report 2011-5108](#) online. For more information on the study, contact [Nancy Baker](#).

High-resolution geospatial data identifying the range of environmental conditions that influence the location of agricultural lands in the conterminous U.S. are described.

- **Tillage Practices in the conterminous United States, 1989-2004** – Access the USGS [Data Series 573](#) online. For more information on the study, contact [Nancy Baker](#).

Methods used to aggregate county-level tillage practices (conservation tillage, reduced tillage, and intensive tillage) to the 8 digit hydrologic unit watershed are documented for the conterminous U.S.

- **Nitrate in the Mississippi River and its tributaries, 1980 to 2008: Are we making progress** – Access the featured article in the [August 2011](#) issue of the Environmental Science and Technology journal. For more information, contact [Lori Sprague](#).

Little consistent progress in reducing riverine nitrate has occurred since 1980 and flow-normalized concentration and flux are increasing in some areas of the Mississippi River basin based on results of the Weighted Regression on Time, Discharge, and Season (WRTDS) statistical method. Flow-normalized nitrate concentration and flux increased between 9 and 76% at four sites on the Mississippi River and a tributary site on the Missouri River, but changed very little at tributary sites on the Ohio, Iowa, and Illinois Rivers. Increases in flow-normalized concentration and flux at the Mississippi River at Clinton and Missouri River at Hermann were more than three times larger than at any other site. At most sites, concentrations increased more at low and moderate streamflows than at high streamflows, suggesting that increasing groundwater concentrations are having an effect on river concentrations.

- **Suspended Sediment/Sand Concentrations and Loads in the Mississippi River Basin, 1940-2009** – Access the USGS [Data Series 593](#) online. For more information, contact [David Heimann](#).

Annual total suspended-sediment and suspended-sand loads are presented at 48 sites within the Mississippi River Basin for water years 1940 through 2009.

- **SPARROW modeling to understand water-quality conditions in major regions of the United States: A featured collection introduction** – The [Featured Collection of the August 2011 issue](#) of the Journal of American Water Resources Association focuses on the application of SPARROW (SPATIally Referenced Regressions On Watershed attributes) models. The regional SPARROW models simulate long-term mean annual stream nutrient loads as a function of a wide range of known sources and climatic (precipitation, temperature), landscape (e.g., soils, geology), and aquatic factors affecting nutrient fate and transport. The Featured Collection includes articles on descriptions and a synthesis of the 6 regional modeling studies of stream nutrients and 1 regional model of dissolved solids, methods used to compile the key geospatial datasets used in the models, an overview of the digital stream networks in the models, and a web-based decision support system that provides access to the regional SPARROW models. Learn more about the regional SPARROW models: [Fact Sheet](#), [Briefing Video](#), [Regional SPARROW models](#). For more information, contact [Stephen Preston](#).

- **Factors affecting stream nutrient loads: A synthesis of regional SPARROW model results for the continental United States**– ([article](#))

- **A web-based decision support system for assessing regional water-quality conditions and management actions** – ([article](#)) ([Decision Support System](#))

Regional SPARROW models

- **Northeastern and Mid-Atlantic regions** – ([article](#))

- **Southeastern United States** – ([article](#))

- **Laurentian Great Lakes** – ([article](#))

- **Missouri River Basin** – ([article](#), [fact sheet](#))

- **South-Central United States** – ([article](#))

- **Southwestern United States – accumulation of dissolved solids** – ([article](#))

- **Pacific Northwest** – ([article 2011](#))

Supporting Articles

- **Digital hydrologic networks supporting applications related to spatially referenced regression modeling** – ([article](#))

- **Nutrient loadings to streams from municipal and industrial effluent** – ([article](#))

- **A multi-agency nutrient dataset used to estimate loads, improve monitoring design, and calibrate regional nutrient SPARROW models** – ([article](#))

- **The regionalization of national-scale SPARROW models for stream nutrients** – ([article](#))

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