INDIANA WATER RESOURCES RESEARCH CENTER

Our mission is to coordinate the intellectual and physical resources of Indiana's universities, state agencies, and industries to resolve technical, economic, and other problems associated with water resources management, use, and preservation.

2004 Research Awards

Hydrologic and land use control on the nature and cycling of organic carbon in mixed-land use watersheds in Indiana

Timothy Filley, Department of Earth and Atmospheric Sciences, Purdue University

Terrestrial organic carbon represents the largest pool of actively cycled carbon (soil and living plants). This organic terrestrial matter (TOM) is transferred to streams and rivers from soil and litter reservoirs. The export of the TOM into these water resources and the subsequent biological and physicochemical processes that alter the material as it is mobilized impact the receiving waters and even global carbon budgets. Understanding how short-lived hydrologic events (snow melts, punctuated storm events) and land use affects the biogeochemical cycling of TOM is the focus of this study.

Knowledge of the fate of TOM is critical as rivers provide the conduit for co-mobilized metals and pesticides that are bound or sorbed to it. Furthermore, at the regional and global scale, the strong relationship between TOM input and runoff suggests that model predictions of increased frequency and severity of storm events that will accompany global warming-induced climate change will have a positive impact on the export of carbon to aquatic systems.

In this collaborative proposal with USGS-Indianapolis we will perform a detailed assessment of how the chemistry and physical structure of TOM change as it is exported from watersheds through tile drainage and overland flow to receiving streams. We will relate the frequency and intensity of hydrologic pulses to the resulting dynamic nature of the quantity, source, structure, and size distribution of TOM in small agricultural watersheds in central Indiana that ultimately discharge to the main stem of the Wabash River.

Norms, public opinion, and preservation of non-charismatic aquatic and riparian species

Leigh Raymond, Department of Political Science, Purdue University

More than half of all endangered species in Indiana rely on waterways, wetlands, and coastal areas for their critical habitat. Managing water resources for the protection of these species is therefore a critical public policy concern. Public attitudes toward species preservation play an important role in the implementation and legitimation of these policies. While public support for large mammals and other so-called "charismatic mega-fauna" is consistently strong, support for other species, including those like mussels and reptiles common to aquatic systems, are less well understood. This study proposes to investigate the public credibility of various justifications for protecting endangered species common to aquatic systems, rather than their more charismatic mammalian counterparts. Specifically, the project will document public attitudes about protection of two endangered species found in Indiana: a wetland reptile (the Eastern Massasauga) and a freshwater mollusk (the Fanshell Mussel). Both are "non-charismatic" in important ways: one is a poisonous rattlesnake while the other lives buried in river sediment and is largely invisible to Indiana residents. This study proposes a series of focus groups and a large-N mail survey of residents of Tippecanoe County to test what arguments are most or least persuasive in supporting protection of these riparian and aquatic species. In particular, the study will investigate whether *practical* arguments based on the species' potential utility to human beings fare better or worse than a more basic, *normative* argument regarding the species intrinsic right to continued existence. The study hypothesizes that contrary to current agency practice, a more fundamental ethical argument will be most persuasive among the public for species of this "non-charismatic" nature. Better understanding of these public attitudes and norms should aid the implementation and legitimation of further measures to protect aquatic species and the threatened and disappearing water-based habitats upon which they rely for survival.

Overleaf

INDIANA WATER RESOURCES RESEARCH CENTER

Our program supports research in all areas of water science with particular emphasis on agriculture, civil engineering, biogeochemistry, geology and wildlife management.

Potential of Controlled Drainage to Reduce Nitrate Contamination at the Watershed Scale

Jane R. Frankenberger, Department of Agricultural and Biological Engineering, Purdue University and Eileen Kladivko, Department of Agronomy, Purdue University

About 50% of all cropland in Indiana is artificially drained with subsurface tile drainage systems. While artificial drainage is necessary for insuring field operations and crop production, it has environmental costs, increasing nitrate-N load to surface water. Controlled drainage has been shown in plot- and field-scale studies to reduce nitrate losses from subsurface-drained soils. Control structures are used to hold the water table at a higher level during the non-growing season in November to March when most of the drainage and nitrate loss occur. Controlled drainage could have an important impact on annual nitrate load in streams and rivers that drain heavily-drained watersheds. Although field and modeling studies provide good estimates of potential nitrate loss reduction at the field scale, no studies exist that estimate how much nitrate reduction is possible from implementation of controlled drainage at the mid-size watershed scale. The goal of this study is to quantify the potential benefit of controlled drainage in reducing nitrate-N load to surface water in a mid-sized watershed, under the weather and soil conditions in Indiana. DRAINMOD-N will be used for analysis and prediction, and Monte Carlo simulations will be used for uncertainty analysis. The results will include the potential percent reduction in nitrate-N load that would occur if all cropland that is suitable for controlled drainage has that practice in fallow season and the confidence intervals for the estimates. This information can be delivered to producers, policy-makers, and rural communities to encourage improved drainage water management in Indiana.

Photo: Brent Dalzell

Characterizing Errors in Distributed Hydrologic Modeling

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Estimating surface water flow after a storm is critical in our humid region for flood analysis and water quality predictions among numerous other uses. As this life-critical resource becomes endangered by pollution, we look for the science and engineering of water flow paths to help us better provide sustainable and clean water for human needs. Watershed hydrology is a mix of interacting processes that cuts across cascading and overlapping scales of time and space. Modeling these systems offers a unique tool for understanding and integrating the multi-scale processes when real observations and field monitoring fail due to the prohibitive time and cost required. To fully capture the real hydrologic system, modeling watershed hydrologic processes have survived years of empirical estimates. Although simple to develop and apply and are still in good use, empirical modeling fails to bring the accuracy, precision, and the needed details of the processes and their intermediate output. Physically-based and process oriented modeling has the potential to overcome this shortcoming; however, these more complex tools face numerous challenges. Addressing some of these challenges is the goal of this proposal. This research proposal is intended to establish the relationships among the hydrologic parameters and how they are impacted by the scales of the watershed and to evaluate the sources of errors associated with the numerical solution of overland flow. The result of this work will generate guidelines that will be implemented by hydrologic models to improve their efficiency and accuracy of simulation.

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