Abstract #74

Characterizing Water Quality in the Charlotte Harbor Florida Estuaries Using a Trained Volunteer Corps: 1998-2003 Results of the Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network

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Abstract

The Charlotte Harbor Estuaries include 6 FL Aquatic Preserves and greater than 175,000 acres of exceptional submerged resources. Resources, watershed and management issues vary throughout the diverse interconnected estuaries. Aquatic Preserve management focuses on resource management, research and education. Water quality information is essential for estuarine health characterization. Historically, comprehensive water quality monitoring throughout the system has been limited. In 1996 the Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network began as a cooperative project with the FL Department of Environmental Protection, Charlotte Harbor Environmental Center and Charlotte Harbor National Estuary Program. A corps of over 70 trained volunteers monitor 19 parameters at 44 fixed stations synoptically once a month at sunrise on the 1st Monday. In-situ measurements are made of tide, water clarity, salinity, dissolved oxygen, pH and temperature. Lab analyses are conducted for TP, TN, chlorophyll a, color and turbidity by the FL Department of Environmental Protection Lab. The FL Trophic State Index is used to characterize estuary health from the data. During 1998-2003, conditions in the Charlotte Harbor Estuaries ranged from good to fair. These results represent the 1st system wide characterization of water quality. Data from the ongoing monitoring program is used to complement other monitoring programs and direct resource management activities.

Abstract #75

Lake Erie Indicator Monitoring 1983-2002

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Biographical Sketches of Authors
David Rockwell is an environmental scientist in the Monitoring Indicators and Reporting Branch (MIRB) within the U.S. Environmental Protection Agency's Great Lakes National Program Office (GLNPO) with training and experience as a limnologist. Since 2002, he has served as the project officer for the Biological Monitoring Program.

Glenn Warren is the monitoring team leader for MIRB within the U.S. EPA's GLNPO. He is a biologist specializing in the design, implementation, and interpretation of Great Lakes environmental monitoring programs. Dr. Warren has led the Lake Michigan Mass Balance Study since its start in 1994.

Paul Bertram is the U.S. lead for the Great Lakes Environmental indicators project through the State of the Lakes Ecosystem Conference process for the MIRB within the U.S. EPA's GLNPO. Dr. Bertram is also the U.S. lead for the preparation team of the binational report State of the Great Lakes 2001 and 2003.

Abstract
The U.S. EPA Great Lakes National Program Office maintains a long term, open water, monitoring program on the Laurentian Great Lakes. Accelerated eutrophication of the Great Lakes has been recognized for over sixty years. Control of accelerated eutrophication required controlling external phosphorus loads. The general success of the phosphorus load control in all of the Great Lakes can be seen in decreases in total phosphorus (TP) concentrations in all three basins of Lake Erie during the 1980's. However, 0.2 ug-P/L/yr increases in the Central Basin ($p<0.001$) and 0.7 ug-P/L/yr increases in the Western Basin ($p<0.005$) in seasonal TP concentration since 1989 and cessation of decreases of TP concentrations in the Eastern basin suggest a change in Lake Erie's ecosystem. These internal changes are occurring in spite of external phosphorus loads controls.

From 1983 to 1989, Central Basin TP and dissolved reactive silica DRS) responded as expected by the Schelske and Stoermer hypothesis, that as over enrichment of TP declined, severe SI depletion was diminishing (4.4 ug-Si/L/yr increase ($p<0.01$)). However, post 1989, TP increased and DRS increased or decreased in tandem during 1989-1997 and 1997-2001 respectively.

Dissolved oxygen (DO)monitoring data collected from 1983 to 2002 were analyzed for trends with time. Decreases in DO depletion rates were detected prior to 1989. Since 1990 no change in DO depletion rates has been observed.

A temperature increase was detected in the Central Basin of 0.015^{o}C/yr (1983 to 2002). These results are close to a commonly accepted value for global warming of 0.02 ^{o}C/y

Detection of temporal trends in transparency across North America using volunteer-collected "snapshot" data

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Abstract

The Great North American Secchi Dip-In has continuously collected transparency data in North America since 1994. Volunteers collect the data during two weeks spanning Canada Day (July 1) and July 4th. More than 31,000 transparency records have been collected on 6,200 waterbodies. The Dip-In works through existing volunteer monitoring programs, which provides assurance that the data comes from trained volunteers.

Transparency values obtained during this "snapshot" event are found to have a low year-to-year within-lake variability (5-6% RSD) and even lower if the data were detrended (3-4% RSD).

Using data from waterbodies with five years or more of data, we used a Kendall's Tau-b to detect temporal trends. Only 54 of 1,362 waterbodies were found to have significant (P = 0.5) decreases in transparency, while 61 had significant increases in transparency.

An Ohio volunteer database was used to detect weekly variability throughout the season. The highest weekly variability occurred during the early spring. The second peak (3-4% RSD) occurred in late June, decreasing thereafter into the fall. Year-to-year transparency trends varied throughout the season in slope and significance throughout the season, suggesting that "snapshot" monitoring can provide an estimate of change for a specific seasonal period. The comparability of trends obtained by "snapshot" monitoring and whole-season monitoring will be discussed.

A Reality Check on Water Monitoring

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Biographical Sketches of Authors

Pixie Hamilton has worked as a hydrologist for the USGS since 1984, primarily doing regional ground-water modeling and regional and national water-quality assessments. She currently serves as a Staff Hydrologist and Water Information Coordinator for the National Water-Quality Assessment (NAWQA) Program, which assesses water-quality conditions and trends in some of the nation's most important streams and aquifers. Her current emphasis largely is on communicating research and technical implications of NAWQA information to government, research, and interest-group partners in order to help guide water-resource management and protection strategies and policy.

Mr. Miller has worked for the USGS more than 25 years in both Oregon and at the National Center, Reston Virginia. His academic background included degrees in Mathematics and Engineering. His field experience has included water-quality studies of urban runoff, ground-water quality, atmospheric deposition, and dissolved oxygen modeling in riverine systems. For the past 9 years, he served as the Chief of the National Water-Quality Assessment (NAWQA) Program, which is an assessment of the most important streams and aquifers in the Nation. Mr. Miller currently serves as the Chief of all USGS water-quality programs.

Abstract

The National Water-Quality Assessment (NAWQA) of the U.S. Geological Survey (USGS) has completed its first decade of studies in 51 of the Nation's major river basins and aquifers, documenting complex contaminant patterns that have important implications for water-resource monitoring. Studies show the prevalent occurrence of complex mixtures of volatile organic compounds, nutrients, pesticides, and their chemical breakdown products in streams and ground water in basins with significant agricultural or urban development. Exposure is complicated by lengthy periods of low concentrations punctuated by brief seasonal or storm-event pulses of much higher concentrations. Water-quality patterns show low-level detection of new and emerging contaminants (such as hormones and pharmaceutical compounds), as well as the legacy of persistent compounds used historically (such as DDT). In addition, findings demonstrate the significant dual role of chemical contamination with physical disturbance to stream habitat in the degradation of aquatic communities. Overall patterns reflect the controlling importance of natural features and land practices that make some watersheds more vulnerable to degradation than others over time.

NAWQA's findings demonstrate the need for improved monitoring that better recognizes spatial and temporal complexities in contaminant occurrence and exposure (including mixtures, breakdown products, and seasonal pulses); interrelations among water, land, and aquatic communities; the importance of land and chemical use, natural features, and management practices that control degradation; and, the need for multiple sampling and long-term monitoring for successful solutions and evaluation. Such changing expectations for monitoring are critical for cost-effective water-resource management, standards, and policies at local, state, and national levels.

EPA's Integrated Reporting Guidance

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Abstract
EPA has developed guidance that encourages States to provide a single water quality monitoring and assessment report (the integrated report) that combines the comprehensive 305(b) report on water quality and the CWA section 303(d) list of waters for which TMDLs are required, while also satisfying the requirements of CWA section 314.

The Integrated Report Guidance (IR) uses 5 discrete reporting categories, representing varying levels of water quality standards attainment, ranging from Category 1, where all of a water's designated uses are met, to Category 5, where a pollutant impairs a water and a TMDL is required.

The IR emphasizes the need for sound assessment methodologies and thorough documentation of the links between water quality standards and the rationale for categorization. It also describes acceptable minimum data and sample size requirements in identifying impaired waters.

The IR promotes the use of probability based monitoring and the rotating basin approach to develop State monitoring programs that balance the ability to conduct broad scale analyses of water quality conditions with the monitoring necessary to make scientifically and statistically sound categorizations of waters.

The IR emphasizes the importance of the development and consistent application of a "geo-referencing" scheme to report water quality of each defined segment, document changes in that segment, evaluate the effectiveness of management actions to attain and maintain water quality, and to obtain insights into important ecosystem processes occurring in the segment.

Who's Monitoring the Water – A Web Based Tool for Tracking Water Quality Monitoring in Texas

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Biographical Sketch of Author
David Cowan coordinates the Clean Rivers Program for the Lower Colorado River Authority in Austin, Texas. Prior to his experience as a Program Manager, he was a Fishery Biologist, Laboratory Analyst and Industrial Pretreatment Specialist.

Abstract
Entities often monitor water quality without knowing that others are monitoring the same sampling point – duplicating efforts and wasting resources. This lack of awareness is a result of poor communication among sampling entities, something that should not take place with today's Internet environment.

The Lower Colorado River Authority (LCRA) created an interactive Web-based water quality monitoring schedule that increases communication between monitoring entities and creates an awareness of geographically dispersed water quality monitoring activities. The schedule is in a table format that displays site location, entity responsible for sampling, monitoring frequency and parameters. Although anyone with Internet access can view the data, only the monitors can edit their information, ensuring that the database contains accurate, comparable data.

The electronic schedule reduces duplicative monitoring, freeing resources to monitor at sites where data may not be collected otherwise. It is updated annually simplifying budget preparation and planning for monitoring associated with 305(b) assessments.

A Texas Clean Rivers Program partner, the Lower Colorado River Authority uses the schedule to track ten entities that monitor water quality in the 42,000 square mile Texas Colorado River basin. This tool has increased personal communication among those monitoring entities, led to resource sharing, data sharing and a better understanding of what monitoring is occurring in the Colorado River basin.

A Review of NCASI's Interests And Activities In Water Information and Research

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Biographical Sketch of Author

Dr. McLaughlin is a Principal Research Scientist with NCASI, and currently has a key role in the design and implementation of the organization's water science investigative program. Prior to joining NCASI in 2002, he worked for five years as a consulting scientist responsible for the design, implementation, and communication of technical studies at contaminated sediment sites, and nine years as an environmental scientist with a pulp and paper manufacturer.

Abstract

In 1943, in recognition of the role of scientific information in addressing the pulp and paper industry's environmental concerns, the National Council for Air and Stream Improvement (NCASI) was created. NCASI is a non-profit membership funded organization whose mission is to address, through its research program, the environmental information needs of the forest products industry. NCASI's member companies collectively produce over 95% of the pulp and paper and a sizeable fraction of the wood products manufactured in the United States. The forest products industry depends on water resources and on water information. In the past several decades, industry impacts on water quality have been reduced as the tools and knowledge needed to manage water quality concerns have evolved. Yet, important information gaps remain as new environmental endpoints, objectives, and associated regulations are established, new methods to assess and manage water quality are developed, and economic demands on the industry continue to require efficient solutions to water quality problems. Today as in the past, the development and use of water-related science and information is the focus of a significant portion of NCASI's overall technical studies program. NCASI has several research activities designed to reduce information gaps on the condition of the industry's receiving waters, and the effects of its discharges on water resources. This presentation will provide an overview of NCASI and its water quality related research program, including summaries of its Long Term Receiving Water Studies initiative and some current uses of hydrologic and other water information.

A Dynamic Monitoring Program – Turkey Creek Watershed Case Study

Timothy D. Steele[1], Michael W. Crouse[2], and Theresa Tiehen[3]

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Dr. Steele's career encompasses nearly 38 years in water-quality hydrology and regional assessments of water resources. He has managed many multidisciplinary projects, hydrologic baseline and modeling studies for water-resources planning and management, and mining-related projects. He has consulted on projects dealing with hydrogeochemical interactions, ground-water contamination, aquifer and lake restoration, tailings disposal, hazardous waste/residuals management, design/evaluation of hydrologic monitoring networks, statistical analysis of hydrologic data, stream/subsurface modeling, use-attainability analyses, stream standards, total maximum daily loads assessments, regional ground-water planning, and international water-resources. He has given expert testimony and litigation support. He has served as a technical consultant to the Colorado Department of Transportation (CDOT) since 1999 regarding hydrologic and water-quality assessment of several highway-improvement construction projects through design and implementation of monitoring programs.

Mr. Crouse has been a professional hydrologist for the past 15 years. His work experience includes project management and principal-hydrologist positions for numerous transportation, mining, and other environmental projects. He also has conducted several water-quality investigations that involve design and implementation of stormwater-runoff monitoring programs to assess non-point sources of pollutants. His responsibilities have included characterization of baseline hydrology and water-quality conditions, design and implementation of monitoring programs, hydrologic analyses, water-quality modeling, and NEPA-document preparation.

Ms. Tiehen has been a transportation/environmental planner for the Colorado Department of Transportation (CDOT) for 20 years, managing the watershed and hazardous-waste programs for Region One. She has had wide experience with highway-related water-quality issues, including those involving NPDES and stormwater permitting, Superfund, and implementation of source controls along major highway corridors. She holds a masters degree from the University of Colorado in Public Administration, specializing in Environmental Policy and Law and specifically focusing on nonpoint-source water pollution.

Abstract

Since 1990, various water-quality monitoring-program components have been operating in the Turkey Creek watershed, located west of the Denver metropolitan area, Colorado. A brief historical perspective of the first two components will be provided. For the 1999-2003 period, a third (and final) monitoring component has been operating specifically to assess effectiveness of best management practices (BMPs) associated with highway-construction improvements along U.S. Highway 285. For each of the last five years of network operations, changes have been made in monitoring sites, constituents analyzed, and, to a lesser extent, scheduling of sampling surveys. During- and post-construction monitoring has demonstrated the dynamics of this somewhat unique monitoring-program network design. Streamflow and water-quality data collected in these monitoring-program components were linked to detailed display and assessment of the resultant data, preparation of annual monitoring reports (with comparison with previous year's data), and presentations before stakeholders and regulatory entities involved in water-quality management in the watershed. Finally, cooperation with concurrent data-collection and hydrologic-analysis investigations in the watershed was promoted.

Bugs & TMDLs: An Evaluation of Macro-Invertebrate Communities in the St. Johns River, Florida

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Biographical Sketches of Authors

Michelle is an environmental scientist contracted to the St. Johns River Water Management District. She has over 10 years experience in estuarine and riverine ecology. The investigation of macro-invertebrates has come naturally given her Cajun heritage and appetite for those organisms that are spineless, hard shelled, and boiled with spices! She has evaluated macro-invertebrate communities in the Gulf of Mexico and in oligohaline (Lake Pontchartrain) and blackwater river habitats (St. Johns River). Michelle is currently investigating relationships of adjacent land use on macro-invertebrate communities within SAV beds and, separately, land use effects on first order streams.

Nadine received a B.A. in Geography in New Zealand in 1999 then spent two years helping to start a GIS Division for a surveying firm in Boston. She now works for the environmental engineering firm, Jones, Edmunds and Associates, as an onsite GIS consultant to the St. Johns River Water Management District. Her work supports environmental science research for scientists working in the Lower St. Johns River Basin. Major projects to date include: GIS based surface watershed delineation, GIS based watershed modeling, SAV and sediments mapping and hyperspectral imagery interpretation.

Dean received his B.S. in Biology from the University of Texas, Arlington and his Ph.D. in Biology from Arizona State University. Graduate research included ecosystem ecology, food web dynamics, and molecular ecology. Post-doctoral work at Arizona State included reservoir ecology and management. Currently he is an environmental scientist with the St. Johns River Water Management District in Florida. His research focus is aquatic macrophyte ecology and biology, stream ecology, and wetland ecology.

Abstract

The St. Johns River (SJR) is a unique blackwater system in northeast Florida that is influenced by salt water from subterranean spring flow and the Atlantic Ocean. It supports a diversity of both freshwater and marine species. This estuarine system has been identified as an impaired water body and listed on the EPA 303(d) list due to problems associated with cultural eutrophication. Algal blooms, fish disease, fish kills, loss of aquatic habitat and bacterial contamination have been identified as biological indicators of poor water quality. The St. Johns River Water Management District (SJRWMD) is currently implementing management strategies for developing and identifying biologically sound TMDLs (total maximum daily loads) and PLRGs (pollution load reduction goals). This process includes an evaluation of macro-invertebrate communities within hydrologic sub-basins. Invertebrate taxa data are collected and statistically evaluated within sub-basins that vary due to land use patterns, soils, and hydrology. These data are utilized to evaluate sub-basin conditions and any potential changes due to implemented management strategies. Study and monitoring results will be presented and discussed within the context of TMDL implementation and SJRWMD natural systems program goals.

Abstract #83

Susquehanna Nutrient Assessment Program

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Biographical Sketch of Author

Kevin McGonigal is a Water Quality Program Specialist in the Watershed Assessment and Protection division of the Susquehanna River Basin Commission (SRBC) in Harrisburg, PA. For the past two years, he has worked as project manager of the Susquehanna Nutrient Assessment Program at SRBC, which monitors nutrient and suspended-sediment concentrations at six sites throughout the Susquehanna River Basin. Kevin is also working with the Chesapeake Bay Program's Non-tidal Water Quality Workgroup to establish a uniform basin wide monitoring network encompassing all six Bay states; Virginia, West Virginia, Maryland, Delaware, Pennsylvania, and New York.

Abstract

Due to excessive inputs of nutrients and suspended sediment, the Chesapeake Bay has been placed on EPA's Section 303(d) list of impaired waters. The Chesapeake Bay Program, a volunteer based program tasked to reduce nutrient and sediment inputs to the Chesapeake Bay, is currently working with the six Bay states in an effort to improve water quality and remove the Bay from the 303(d) list. This effort involves the use of computer models to quantify the amounts of these constituents entering the bay annually. The accuracy of these models is very dependent on consistent monitoring data to calibrate the system. The Chesapeake Bay watershed consists of six states each having varied monitoring programs and objectives resulting in water quality data that currently are inconsistent.

The Susquehanna River Basin Commission manages a comprehensive program to quantify the amount of nitrogen, phosphorus, and suspended sediment reaching the Bay from areas upstream of six monitoring sites on the Susquehanna River and major tributaries in Pennsylvania. SRBC's monitoring program involves sampling at these sites bimonthly as well as during high flow events. These six sites are critical calibration sites for the Chesapeake Bay model and watershed model being utilized in the Bay restoration effort. Currently there is collaboration between all the bay states to adjust current monitoring programs to mimic the SRBC program to produce a uniform monitoring network for the entire Bay. This effort entails the collective development of consistent monitoring goals regarding parameters, methods, frequencies, and site locations. Specific goals include establishing a routine sampling regime to allow for proper trend analysis and sampling during various high flow events to allow for better load estimation.

Use of Monitoring Information to Identify and Implement Water Quality Improvements

Tyler Baker and Don Dycus

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Abstract

The Tennessee Valley Authority (TVA) began a program to systematically monitor the ecological condition of reservoirs in the Valley in 1990, termed Vital Signs Monitoring. The program was designed to provide the necessary information from key ecological indicators to evaluate current conditions, provide data for comparing future water quality conditions, and to target detailed assessment studies if significant problems are found. To inform the public and increase their involvement in water resource improvement activities, TVA developed Reservoir Ecological Health scores, a communication product appropriate for the general public.

The ecological health of Chatuge and Nottely Reservoirs has been monitored since 1991 and a downward trend in ecological health has been documented. TVA watershed teams used this information to identify the Chatuge and Nottely watersheds as areas in need of improvement and/or protective actions. This information was instrumental in generating interest by public and local governments and helped the Hiawassee River Watershed Coalition (HRWC) to develop a locally led effort to improve water quality. The watershed coalition has been successful in identifying issues, developing action plans and securing funding for improving water quality. In 2002 and 2003, eutrophication studies were initiated for Nottely and Chatuge, respectively. This includes developing reservoir water quality models using CE-Qual-W2 and the HSPF Model, Hydrologic Simulation Program Fortran**,** a U.S. EPA program for simulation of watershed hydrology and water quality, to aid in developing future action plans and implementing water quality improvement and protection projects within the watersheds.

Establishing Nutrient TMDLs for Multiuse Reservoirs

Chris L. Johnson[1] and Brian J. Watson[2]

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Biographical Sketches of Authors
Chris L. Johnson is an environmental engineer for the Alabama Department of Environmental Management with 11 years of experience in environmental/regulatory management. Mr. Johnson's primary responsibility with ADEM is managing the Total Maximum Daily Load (TMDL) Program for the State of Alabama. Other responsibilities include providing technical support for 303(d) development, 305(b) reporting, water quality monitoring, and technical support for various projects ongoing throughout the State of Alabama. Mr. Johnson has also been involved with the review, development, and revision of water quality standards, preparation of use attainability analysis, and assistance in the rulemaking process for water quality standards.

Brian J. Watson is a civil/water resources engineer for Tetra Tech, Inc. specializing in environmental engineering and water resources engineering, including hydraulics, hydrology, hydrodynamic and water quality modeling, and land development. Mr. Watson has 5 years of professional experience including a working knowledge of various watershed, groundwater, hydrodynamic and water quality models. Mr. Watson has performed numerous hydrologic and hydraulic studies for various land development projects, and has worked on a variety of Total Maximum Daily Load (TMDL) projects. Mr. Watson has worked for various clients including, EPA (Headquarters, Region IV, Region IX, and Region X), Army Corp of Engineers, GAEPD, ADEM and TDEC.

Abstract
Nutrient over-enrichment of surface waters has been a long-standing problem throughout the United States. According to EPA's 1998 305(b) Report to Congress, nutrients were the leading cause of impairment to lakes and reservoirs. Like the majority of other States, Alabama has several impaired waterbodies as a result of excessive nutrient loading. In response to this "growing" concern, the Alabama Department of Environmental Management (ADEM) has made the development and implementation of nutrient criteria and subsequent Total Maximum Daily Load (TMDL) development a top priority within Alabama's Water Protection Programs.

In 1996, five of the six reservoirs located within the Coosa River Basin were identified as being impaired for nutrients and subsequently placed on Alabama's 303(d) list of impaired waterbodies. These reservoirs serve multiple uses, such as hydroelectric power generation, flood control, water supply, fishing and swimming, therefore setting the appropriate nutrient targets and establishing the appropriate pollutant (i.e. phosphorus) load reductions to meet such targets is a complex and difficult undertaking. This presentation is intended to provide an overview of the methods used by ADEM to develop the TMDLs for several reservoirs within the Coosa River Basin of Alabama. Specific topics of discussion will focus on nutrient target/criteria development and the various modeling tools, data and approaches used in developing the TMDLs.

USGS National Water Quality Data and Maps on the Web

Sandy (Alex K.) Williamson[1] and Nate Booth[2]

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Since 1996, Sandy Williamson has been team leader of the National Water Quality Assessment database activities (water.usgs.gov/nawqa/data). From 1991-97, he led the Central Columbia Plateau NAWQA study unit team, who produced 25 publications with a combined distribution of nearly 100,000 (wa.water.usgs.gov/ccpt). He has worked for the USGS since 1976, previously in Austin, and Sacramento. He completed regional modeling on 2 Regional Aquifer System Analysis (RASA) studies, reported in 2 USGS Professional Papers, as well as dozens of other reports and journal articles. He has a M.S. in Civil Engineering-Water Resources from California State University, Sacramento (1981), and a B.S. in Applied Geomorphology from Western Washington State University (1976). His interests are in web-based presentations of scientific studies and data, effective use of statistics, systems analysis, and ground-water flow and quality. Since 1999, Nate Booth has worked as a principal information systems analyst within the Database Applications Unit of the USGS Wisconsin District Office. His main focus has been in designing, developing, and hosting the National Water Quality Assessment's data warehouse. Other project areas include USGS Environmental Vulnerability Portal, USGS Mobile Computing System, USGS Publications Data Warehouse, USFWS/USGS Wetlands Mapper, USGS National Map, State of Wisconsin Fish and Habitat Data System. He has worked for the USGS since 1997. He has a B.S. in Civil/Environmental Engineering from University of Wisconsin – Madison (1998). His interests are in applying data warehousing architecture and technology to meet today's environmental research needs.

Abstract

The U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program began collecting chemical, biological, and physical water-quality data from 51 large watersheds across the Nation in 1991. In 1999, USGS developed a data warehouse (DWH) for national and regional analysis of data, making most of it available to the public in 2000. Several mapping capabilities were added in 2001. The 2nd decade of NAWQA, in which 42 basins will be resampled, began in 2002. Graphing capabilities and more ecological data were added to the DWH in 2003. The DWH currently contains and links the following data:

- Chemical concentrations in water, sediment, and aquatic tissues
- Ecological data on stream habitat and community data on fish, algae and invertebrates
- Related quality control data
- Stream site, basin, well and surrounding area characteristics, including thousands of variables such as land use, soils, population density.
- Daily stream flow and temperature for several sites in each basin

These data were collected from about 6,100 stream sites and 7,000 wells selected to represent various land uses. About 52,000 water samples were analyzed for nutrients, 34,000 for pesticides, and 11,000 for volatile organic compounds. At about 2,000 sites, streambed sediment and aquatic tissue samples were analyzed for trace elements, pesticides and other organic compounds. About 2,000 fish and 5,000 invertebrate community counts are in the DWH. Most samples were analyzed for 40 to over 100 compounds. Collectively they represent over 10 million water-quality results. The current data set is the largest, nationally consistent water-quality data set for streams and ground water ever assembled. Selected water-quality data can be retrieved in a file or mapped on a web browser for any (or several) county, basin, state, or for all of the U.S. in seconds. These data are readily available to government agencies, universities and the general public to address critical questions about the nation's water quality.

Development principles to maximize functionality while staying on time and on budget included maximum use of state-of-the-art off-the-shelf Oracle and MapInfo software [no product endorsement implied], and development by USGS staff with outside consultants.

More information, data retrieval and mapping tools are at http://water.usgs.gov/nawqa/data.

Increased Capabilities for Community-Based, Water Data Analysis and Outreach

Sergio S. Ruiz Córdova and William Deutsch

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Biographical Sketches of Authors

Sergio is a marine biologist who has worked in the Department of Fisheries and Allied Aquacultures at Auburn University since 1994. He has been a Data Quality Coordinator for Alabama Water Watch since April 2001, maintaining the statewide database and creating data reports. In addition to AWW responsibilities, he collaborates in the design and developing of a database for Global Water Watch projects and works with the Ecuador Water Watch group through AU's International Center for Aquaculture and Aquatic Environments.

Bill Deutsch has been a Research Fellow in the Department of Fisheries and Allied Aquacultures at Auburn University for 16 years. Prior to that, he worked 11 years as a Research Biologist and Director of Aquatic Research for private environmental consultants in Pennsylvania. He has been the Program Manager for Alabama Water Watch since it began in 1992, and directs Global Water Watch through AU's International Center for Aquaculture and Aquatic Environments.
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Abstract

Alabama Water Watch (AWW) is a citizen volunteer water quality-monitoring program coordinated from Auburn University. Since 1993, more than 800 training workshops have been conducted, resulting in 6,200 certifications for physicochemical and biological testing of water. More than two hundred monitoring groups have participated in AWW and 80 are currently active. About 1,600 sites have been monitored from almost 600 waterbodies, and over 35,000 data records have been submitted. A relational database has been developed to effectively store and manage these data, and includes the capacity for online data entry, statistical analyses and public access to summary graphs. Interactive mapping and links to other databases enhance its capabilities to document multi-year trends in water quality caused by both natural and anthropogenic influences. AWW data are becoming one of the most comprehensive sources of water information in the state and are increasingly being used by water professionals and the public in general for the improvement of water quality and policy.

Towards an Integrated Water Quality Toolbox

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Biographical Sketches of Authors

Henry Manguerra is a principal engineer at the Fairfax, Virginia Office of Tetra Tech, Inc. His experience includes the management and technical oversight of projects involving development of GIS, decision support systems, models, databases, and web applications to support various Clean Water Act programs of EPA, states, and the tribes. For example, he was Tt's project manager for EPA BASINS 3.0 development and its customization for various states and tribes. More recently, he led the development of a web-based user interface of STORET and other state's water quality databases to support impairment analysis, 303(d) listing, and TMDL development. The WQA toolbox is the latest in the series of tools that Tt is developing to make water quality and other related geographic and environmental data seamlessly accessible to the end users.

Mr. Zastrow is an aquatic ecologist employed with the Water Resources Division of Tetra Tech, Inc. in Fairfax, VA. His focus is aquatic primary production and his technical expertise includes seven years of experience in water quality data management and spatial analysis. He has been a team leader on projects such as the environmental data warehouse and delivery system for the Great Lakes WATER Institute (Milwaukee, WI), Florida DEP Environmental Data Extraction Tool, and the Southwest Florida Feasibility Study.

Gustavo Lopez is employed as a senior software developer at the Fairfax, Virginia office of Tetra Tech, Inc. He specializes in building enterprise scale web applications using technologies such as Java, XML, and SQL. He has been active in all stages of the development of the WQ Toolbox including design, implementation and testing.

Haihong Yang is a principal software engineer in Tetra Tech, Inc. He has over 10 years of programming experience concentrated in the development and application of GIS and DBMS-driven systems. For the Water Quality Analyzer Toolbox, he is involved in the Viewer customization with MapObjects for map display and impairments highlighting, and water quality data management with Web Service support.

Vaishal Sheth is a GIS software engineer at the Fairfax, VA office of Tetra Tech, Inc. He has practical experience in all parts of the software systems development life cycle including the assessment of user requirements, system design, implementation, testing, quality assurance and deployment.

Abstract

This paper describes a system of integrated software tools focused on conducting impairment assessments of natural surface waters. Leveraging XML, Web Services and GIS technology, the system provides tools for data summarization, trend plots, statistics, reports and impairment status determination of one or more selected waters. A web service allows the desktop users to seamlessly download and update the spatial and water quality data from a central data warehouse. Reference spatial data layers can be viewed in the desktop application through a web feature service without having to download it locally. The application comes packaged with the national water quality standards criteria and also an initial set of standards defined for the El Paso County, Colorado. Users can easily customize the application for their study area by modifying the standards through an intuitive interface. The system employs a modular architecture and comes with a core mapping framework and additional plug-ins for analysis and charting. This makes the system very customizable and expandable to address the needs of different organizations. Another component of the system is a desktop tool that allows data to be transferred from a local database to a central database using custom database field mappings that can be stored for future transfers. Use of XML as a data transfer standard can allow easy integration of the system with other data warehouses, such as EPA STORET. Future development objectives include the construction of a modular model builder allowing fine-grained user constructed analyses and rules.

Water Quality Data Management – Monitoring, evaluating, analyzing and presenting data using WISKI-WQM

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Biographical Sketches of Authors

Dr. Frank Schlaeger is a civil engineer and specialized in water resources management. His thesis at the University of Aachen is about long-term simulation of water quality in mining affected river catchments. After finishing his thesis he moved to KISTERS in January 2002. Since then he worked as quality assurance manager as well as project manager. Furthermore he leads the development of the water quality module WQM.

Stan Malinky, who is bachelor of science civil engineering, is the vice president of JBS instruments. After being project manager of hardware development of hydrological data collection he now serves as senior project engineer and senior sales engineer for the sale of hardware and software for environmental data management.

Dr. Jürgen Stein is a civil engineer and specialized in water resources management. His thesis at the University of Aachen deals with mathematical and physical simulation of flow in natural channels. After moving from the North Rhine-Westphalia State Environment Agency to KISTERS he became head of the division resources management systems. He also serves as general project manager, senior project engineer, and senior sales engineer.

Abstract

The recent adoption of the European Water Framework Directive (WFD) has led to the reforming of the European water laws. The WFD places central emphasis on river basin management as well as water resource management into the future. This is, in particular regarding the qualitative aspects such as the preservation of a good ecological and chemical condition of our inland waters. Because of the need to monitor, quantify and identify the affects of water resources management – and considering the wide range of relevant influencing variables – the application of environmental software is inevitable.

WISKI and its water quality module WQM is a software package for monitoring, evaluating, analyzing and presenting data. WISKI is a client/server system based on relational databases, designed in cooperation with water agency authorities, engineers and hydrologists. It combines the modern standards of data management with advanced tools to collect, edit, store and present time series data to intranet, internet and GIS users. WISKI consists of three parts, a remote data acquisition server (SODA), a central database server for storage and management, and a windows based hydrological workbench. The system allows the automatic and effortless flow of time series data from the measuring site into the database. The data is then reviewed using powerful graphical and tabular interface tools.

The water quality module WQM was developed within the scope of an R&D project. To attain the standards of the WFD the aim of this project was the development of a water quality data management system which allows the tight link to water quantity data as well as the data stream from import of laboratory systems data to automatic data validation, data analysis, automatic calculation of derived values, the export in different formats, and by linking to the WISKI ArcGIS extension the automatic generation of water quality maps.

Monitoring and Testing of Sensors for a Prototype Real-Time Early-Warning System for Water Security

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Eric Vowinkel, Ph.D., is a hydrologist with the USGS in New Jersey. He has been working on water-quality issues for 25 years. Most recently, Eric has been conducting vulnerability assessments of community water supplies in New Jersey as part of NJDEP's Source Water Assessment Program. Eric is the liaison between USGS and USEPA Region 2, Rutgers University, and the University of Medicine and Dentistry of New Jersey. He is a member of the USEPA's National Distribution Systems Research Consortium and is a past President of the NJ Chapter of the American Water Resources Association.

Ron Baker, Ph.D., is a research hydrologist with the USGS in New Jersey. He has been working on point- and nonpoint-source water-quality issues for the past 16 years. He is project chief of the Early-Warning System investigation and recently served as project chief of a statewide assessment of the vulnerability of ground water in New Jersey to contamination by nitrate.

Jacob Gibs, Ph.D., is a Water-Quality Specialist with the USGS in New Jersey. He serves as a technical advisor to the Early-Warning System project. Jack is a coauthor of the USGS National Field Manual on the Collection of Water-Quality Data.

Rachael Esralew is a hydrologist with USGS in New Jersey. She serves as the field coordinator and database manager for the Early-Warning System project.

Abstract

A prototype real-time early-warning system (EWS) to monitor water supplies for security from accidental or intentional spills is being developed as part of an ongoing 3-year investigation by a consortium that includes the U.S. Geological Survey (USGS), the U.S. Environmental Protection Agency (USEPA), Sandia National Laboratories (SNL), Rutgers University, the New Jersey Department of Environmental Protection (NJDEP), and three water utilities in New Jersey. The investigation consists of three components: (1) monitoring and testing of sensors, (2) modeling source waters and distribution systems to determine optimal locations of sensors, and (3) information management and pattern recognition of water-quality signals for alert systems.

The monitoring and testing of sensors for the EWS concentrates on field testing of the effectiveness of available general sensors, including those measuring temperature, pH, dissolved oxygen, specific conductance, turbidity, chlorine, and oxidation-reduction potential. Specific sensors selected to monitor chemical, biological, and radiological (CBR) contaminants will be deployed in the field after tests by the USEPA Testing and Evaluation Facility or the Environmental Testing and Verification Program, the Department of Defense, the Department of Energy, or other Federal laboratories. Hydrologic-flow and distribution-system models will be used to optimize the location and number of water-quality sensors deployed near source-water intakes (rivers and reservoirs) and in distribution systems.

Sensor signals will be transmitted through the USGS real-time data platform by satellite or by cellular telephone to SCADA systems at the water utilities, SNL, and Rutgers University. If the general and (or) specific sensors detect anomalous water-quality conditions, then alarms will be triggered and appropriate officials warned. To validate the sensor data, water-quality samples will be collected in accordance with emergency-response protocols established by the USEPA National Homeland Security Research Center. These samples will be sent to appropriate laboratories to confirm contaminant presence.

Water Monitoring Systems: the Daphnia- and Algae Toximeter under the Aspect of Quality Assurance and Routine Practice

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Christian Moldaenke is founder and general manager of the bbe company, Germany. As a physicist he has developed various biomonitoring systems. His work focuses on evaluation of biomonitoring data and alarm recognition. He is cooperating with different European working groups dealing with biomonitoring.

Corina de Hoogh is a member of the Kiwa Water Research Team. Kiwa is the Dutch research and knowledge institute for water and associated ecological and environmental questions. Key aspects of her work are innovation and knowledge transfer.

Arco Wagenvoort is an environmental scientist at the Waterwinningbedrijf Brabantse Biesbosch. He is responsible for the control of water quality for drinking water production at different reservoirs in the Netherlands.

Detlev Lohse is a member of the bbe company. He holds a PhD in biochemistry and investigated basic principles of photosynthesis at several German institutions. At bbe he focuses on improvement of toxin registration and fresh water quality assessment.

David Alexander heads the bbe Moldaenke agency in US & Canada and provides consultation on systems for biomonitoring and environmental control.

Abstract

Safeguarding water quality is a key responsibility of municipal authorities and water utilities. Online biotests have proved reliable for recognition of acute toxic substances in real time and are being used in many cases to monitor drinking water and other freshwaters. Multiple combined biotests complement one another at different monitoring stations in the Netherlands. Based on a two-year period of operation the quality assurance for the monitoring station Keizersveer, the Netherlands, is described. Operating effort for daily routine activities is reported. From technical status and maintenance data the system “operationality” is determined. Addition of chemical and physical data from multiple sensors into the real time analysis system provides new ways to detect significant events.

AquaSentinel: A Revolutionary Biosensor System for Primary-Source Water Protection

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Elias Greenbaum is a Corporate Fellow and Research Group Leader at Oak Ridge National Laboratory and a Professor of Biological Physics at The University of Tennessee. He received the B.S. degree in physics from Brooklyn College and Ph.D. in physics from Columbia University. Greenbaum's main area of research is in the field of photosynthesis. He was named 2000 Oak Ridge National Laboratory Scientist-of-the-Year. Greenbaum is a Fellow of the American Physical Society and American Association for the Advancement of Science. He holds 10 patents and is the author of more than 100 publications in peer-reviewed journals.

Miguel Rodriguez, Jr. is a Biotechnologist at Oak Ridge National Laboratory. He received a B.S. degree in industrial microbiology from the University of Puerto Rico-Mayagez and an M.S. degree in life sciences from the University of Tennessee-Knoxville. He is a Research Associate in the Biochemical Engineering Group of the Life Sciences Division. During his career development in ORNL, he has received the following awards: 2002 Significant Event Award, UT-Battelle, LLC; 2000 Significant Event Award, UT-Battelle, LLC; 1999 Technical Support Award, Lockheed Martin Energy Research Corporation; and 1998 Significant Event Award, Lockheed Martin Energy Research Corporation.

Abstract

AquaSentinel is an automated and field-deployable real-time monitoring system for water protection that is based on the fluorescence induction properties of algae that grow naturally in primary source waters. United Defense has acquired an exclusive commercial license from Oak Ridge National Laboratory for this technology in the United States. We report photochemical yield analysis of real-time chlorophyll fluorescence data collected for approximately a year from the Clinch River at a location in Oak Ridge, Tennessee. The Clinch River is the main source of water supply for the City of Oak Ridge. In addition, we report dose-response data collected with the biosensor *Chlamydomonas reinhardtii* after exposure to selected toxic agents. AquaSentinel(SM) uses microscopic algae as biosensors. Fluorescence induction curves are used as indicators of the health of the algae. We have demonstrated that AquaSentinel(SM) can be used by water facility managers as an early warning device. When combined with encrypted data telecommunication and a database-lookup library containing pertinent data for healthy algae, AquaSentinel(SM) provides a practical and effective approach under real-time world conditions to protection of sunlight-exposed primary drinking water supplies and regulation of water quality requirements.

Measurement of Dissolved Oxygen in Biochemical Oxygen Demand Determinations With a Luminescence-based Oxygen Quenching Sensor

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Dr. Jackson has 28 years experience in the development and validation of analytical methods for water, wastewater, and solid waste. As a principle consultant to EPA Office of Water, he has developed, co-developed, or managed the development of over 20 promulgated methods. His long-term research interests have focused around mass spectrometry, chromatography, and solvent-based partition systems. Currently with the Hach Company, Dr. Jackson directs the regulatory sciences activities for EPA and consensus-based method approvals. He earned his Bachelor of Arts degree in chemistry from University of Northern Colorado and a Doctorate of Philosophy in Soil Chemistry from Colorado State University.

Dr. Craig is a research and development chemist focusing on cutting edge spectroscopy technologies as applied to water and wastewater applications and homeland security. After obtaining his Doctorate of Philosophy in Analytical Chemistry from Ohio State University, he served as a Post-doctoral fellow at the Australian National University and University of California, San Francisco in automated interpretation of nD-Protein NMR spectra. Prior to joining the Hach Company, Dr. Craig taught analytical chemistry and instrumental analysis for Louisiana Tech University and the University of Northern Colorado.

Abstract

Dissolved oxygen (DO) is the second most sought out measurement in the operation of wastewater treatment plants. When used to derive the biochemical oxygen demand (BOD) from a wastewater, it becomes a regulatory compliance and process control tool. Consequently, precision and accuracy of the determinant to measure DO becomes a critical issue of interest in estimating the degree of water quality or purification, and calculating industrial discharge loading costs for public owned treatment work (POTW) facilities.

Attempts to measure DO are hampered by a lack of robust analytical techniques that are accurate, precise, easy to use, and resistant to matrix interferences. The two EPA methods approved to measure DO (Winkler titration and Clark-type electrode) often fail to deliver interference free readings that are accurate and precise across the BOD range of 1.0 to10 mg/L, DO. In an attempt to address these measurement deficiencies, a luminescence-based sensor was evaluated as alternative determinant. An in-house side-by-side comparison study with Winkler, Clark-type electrode and luminescence-based dissolved oxygen (LDO) was conducted with reference water and incubated BOD_5 samples.

Initial results indicate that LDO is a superior alternative to Winkler titrations and Clark-type electrodes for DO measurements with respect to accuracy, precision, detection limit, and response linearity. A further nationwide Tier III validation study will be conducted to develop statistically pooled quality control acceptance criteria for EPA method approval.

This presentation will briefly discuss luminescence-based oxygen sensor technology and the results of the initial in-house side-by-side comparison study.