

# Water Resources Update

## USGS Illinois Water Science Center Newsletter

November 2006

**U.S. Department of Interior**  
**U.S. Geological Survey**  
Illinois Water Science Center  
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*Compiled by D.M. Ayers*

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### Message from the Director

On November 9, 2006, I had the pleasure of attending the annual U.S. Geological Survey (USGS) awards ceremony at the USGS National Center in Reston, Virginia. My purpose in attending was to witness two current and two retired members of the Illinois Department of Natural Resources, Office of Water Resources (IDNR-OWR) accepting the John Wesley Powell (Powell) award. The USGS Illinois Water Science Center nominated Gary R. Clark, Director; Donald R. Vonnahme, Director (Retired); Arlan R. Juhl, Chief of Planning Section; and Melvin Allison, Chief of Planning Section (Retired) for the award (see photo on page 8). These four gentlemen were given the award for their longstanding support of the USGS Illinois Water Science Center streamgaging, data dissemination, and research programs. These four gentlemen have been tireless advocates of the streamgaging program and were instrumental in establishing Illinois as the first predominately real-time streamflow gaging networks in the United States in the 1980s.

The Powell award recognizes an individual or group, outside the Federal Government, whose contributions to the USGS' objectives and mission are noteworthy. The first award was given in 1971 and was named for the distinguished scientist and explorer who served as the second director of the USGS from 1881 to 1894, and who made the pioneer exploration of the Colordao River.

While in Reston for this ceremony, I had the pleasure of attending a tour of two of the USGS National Research Program (NRP) laboratories. The tour, led by Pierre Glynn of the USGS, highlighted some of the cutting-edge science ongoing within the USGS in ground-water age dating and source-water determination. This tour served to remind me of the wonderful breadth and depth of science conducted by the USGS. This newsletter contains two articles that overview some of the breadth. The article on the National Geospatial Program activities in Illinois was written by the former Illinois liaison for the USGS Geospatial program, Dick Vraga. Dick will remain involved in Illinois for a time as he helps familiarize our new liaison, Shelley Silch, with all the many geospatial activities in Illinois. Pierre Glynn, Chief of the Eastern Region Branch of Regional Research for NRP, wrote the second article that overviews the USGS NRP. Because of the many activities of NRP, both Pierre and Donna Ayers, editor of this newsletter, had a challenge to keep the article within space limitations. I hope that you enjoy both of these articles.

**Robert R. Holmes, Jr., PhD, P.E.**

# National Geospatial Program Office Activities in Illinois

by  
Richard S. Vraga, Geography State Liaison for Wisconsin and Illinois

The U.S. Geological Survey has realigned its geospatial programs into a National Geospatial Program Office (NGPO) to serve the needs and interests of the geospatial community throughout the Nation. The NGPO strives to engage partners throughout the community in its planning and in ensuring that its activities meet the needs of those on the landscape. By connecting the components of *The National Map* (integrated base data), Federal Geographic Data Committee (FGDC) (coordination, policy, and standards), and Geospatial One-Stop (information discovery and access), and by embracing and communicating the message of the importance of the National Spatial Data Infrastructure (NSDI), the geospatial community and the Nation will realize the vision of “current and accurate geospatial data will be available to contribute locally, nationally, and globally to economic growth, environmental quality and stability, and social progress.”

Since its inception in 2004, the NGPO has been active in Illinois through the efforts of its Geospatial Liaison. The following summarizes three significant initiatives of the NGPO in Illinois: the 2005 orthophoto project, the Innovative Partnership Funds for 2006, and the establishment of a NSDI Partnership Office in Illinois.

## 2005 Statewide Orthophotography

This project to acquire and make available orthophotography for the entire State of Illinois is nearing completion. Initiated by an agreement between the Illinois Department of Transportation (IDOT) and the USGS, the project required cooperation and contributions by 16 Federal, State, Regional and County agencies. To meet user requirements, the project was conducted in two parts. The “Chicago Urban Area,” which is defined by the six county area including Cook, DuPage, Kane, Lake, McHenry and Will Counties, utilized USGS Urban Areas high-resolution orthophotography specifications to meet Department of Homeland Security needs. The second part, consisting of the remaining 96 counties, used National Aerial Photography Program (NAPP) orthophoto specifications as the foundation, with one significant change: the ground spatial resolution for the data was increased from the standard 1 x 1 meter to 0.5 x 0.5 meters per pixel providing the ability to discern greater detail in the photographs. The aerial photography was collected in early 2005.



The results of the 2005 Statewide Orthophotography project are a significant contribution to *The National Map* (TNM), and the data will be available for access and downloading via the TNM Web mapping service and viewer and the Illinois NSDI Clearinghouse. Online since 1997, the Illinois Clearinghouse is maintained and managed by the Illinois State Geological Survey (ISGS). It is part of a network of more than 300 NSDI nodes worldwide, a program managed by the FGDC. Part of the benefit of being affiliated with the NSDI is that all nodes use a common suite of technology tools that allow users to easily search, locate and download geospatial data hosted on one or more of the NSDI servers. As of this date, all orthophotos for the Chicago Urban Area are available from the Illinois Clearinghouse and more than 300,000 files have been downloaded. This effort was assisted by an Assistance Award from the FGDC. The remainder of the state will be “staged”

to the Clearinghouse with a target completion date of October 30, 2006.

## Innovative Partnership Funds

In Fiscal Year 2006, USGS Eastern Region NGPO awarded Assistance Grants to USGS partners to improve elements of the NSDI in the region. Two such awards were made to the Illinois State Geological Survey for two important geospatial activities within the State: the Illinois Clearinghouse, and coordination of geospatial activities.

## The Illinois Clearinghouse

An Assistance Award was made to ISGS to expand the existing Illinois Clearinghouse Web resources into a true Illinois GIS Portal. This new Clearinghouse identity will present a broader array of Illinois data resources to support the expanding needs of the State’s Geographic Information Systems (GIS) user community, and the Illinois Clearinghouse will be a principal contributor to *The National Map* for the State. This project will emphasize content updates so that available data are relevant and current. In recent years, many State, county, and professional organizations in Illinois have launched Web-based mapping applications. The revised Web portal will include metadata about, and links to, known Web mapping applications serving Illinois data. It will include links to other metadata servers and pertinent data sources to make GIS resources for the State of Illinois much easier to discover. In addition, the Clearinghouse will serve critical data sets. Visit the Clearinghouse at <http://www.isgs.uiuc.edu/nsdihome/>

## Illinois Coordination

An Assistance Award was made to ISGS to lead the development of a process for establishing a recognized geospatial coordination mechanism for Illinois. It includes developing a draft strategy and conducting a meeting to raise the level of awareness amongst decision-makers and geospatial professionals for the need and benefits of Statewide geospatial coordination. It will require meetings with geospatial leaders in the State to develop the strategy and a single day seminar to develop broad support for the concept. Guidance will be sought from the Federal Geographic Data Committee and the National States Geographic Information Council.

## NSDI Partnership Office

Since the inception of the NGPO, Illinois has been served by the Geospatial Liaison for Wisconsin and Illinois located in the NSDI Partnership Office in Madison, Wisconsin. It is a goal of the program to establish a NSDI Partnership Office in all 50 states as funding and available talent will allow. An NSDI Partnership Office was established on September 5, 2006 at the USGS Illinois Water Science Center and is staffed by Shelley Silch, Geospatial Liaison for Illinois.

Shelley began her employment with the USGS in Rolla, Missouri in May 1976 as a Word-Processing Clerk (Typesetter). Shelley noted, "This was back in the good old days when maps were created by hand. I set all of the type that went on each of our topographic maps, inside the map as well as along the collar. (<http://erg.usgs.gov/isb/pubs/booklets/topo/topo.html>)." Shelley's map-making experience broadened in the 1980's when she transferred to the Branch of Photogrammetry, converting to the Cartographic Technician series. In this capacity, she compiled map manuscripts using PG-2 and B-8 vintage stereoscopic plotters.

Shelley left government service in 1982, traveling with her husband and children to a number of U.S. Air Force Bases. One notable exciting, yet somewhat scary, venue was when they spent three years in Athens, Greece. While in Greece, she gained a greater appreciation of her U.S. citizenship. Shelley returned to government service with the Rolla USGS in 1991 where she was employed as a Typesetter once again. However, this position was short-term because the developments being made in the mapping world had shifted from producing maps by hand to producing maps digitally.

Shelley soon transferred to the Production Operations Branch as a Cartographic Technician and began revising and updating digital maps. Seeking a degree in Geological Engineering, Shelley enrolled at the University of Missouri-Rolla as a part-time student. She was selected for a conversion to Geographic Information Systems (GIS) specialist, and she began working with GIS data and an assortment of GIS applications. After a conversion to a Physical Scientist series, she devoted her time on research projects related to remote sensing.

Shelley and her husband, Rich, relocated to Illinois in early September. Rich is a recent retiree from the USGS and is bringing a number of projects with him as he enjoys working on old trucks. They have five adult children who have left the nest. One daughter and husband reside in Wisconsin while the remaining children make their homes in Missouri. Shelley and Rich also have two granddaughters and two grandsons in Missouri. Shelley relished in the notion that

email and digital cameras are part of everyday life. Shelley enjoys gardening, sewing, stained glass projects and lessons in Carpentry 101 from Rich!

Following is a summary of the specifications used for the two parts of the project.

### Chicago Urban Area

**Area of Coverage:** Entirety of Cook, DuPage, Kane, Lake, McHenry and Will counties (see **photo previous page of Shedd Aquarium**).

**Imagery Source:** True (natural) color film. This was acquired during the leaf-off period from March 1 to April 30, 2005.

**Projections and Datum:** Illinois State Plane Coordinate System (SPCS), East and West zones; and Transverse Mercator, Universal Transverse Mercator (UTM) grid zones 15 and 16; NAD 83 datum.

**Spatial Resolution:** 1 x 1 foot ground sample distance per pixel for the SPCS orthoimagery, and 0.3 x 0.3 meter ground sample distance per pixel for the UTM orthoimagery.

**Data Format:** GeoTIFF with accompanying FGDC-compliant metadata.

**Data Files:** Each orthorectified image tile will represent a 1,500 x 1,500 meter ground area produced at even 1,500 meter grid lines, without overlap between image tiles. Corner coordinates will be based on the UTM grid and shall be evenly divisible by 1,500 meters. Estimated number of image tiles is 4,365 and file size is approximately 73 Mb for each image tile.

### Illinois outside of the Chicago Urban Area

**Area of Coverage:** Entire 96-county Illinois area exclusive of Cook, DuPage, Kane, Lake, McHenry and Will counties.

**Imagery Source:** Black-and-white film. This was acquired during the leaf-off period from February 15 to May 5, 2005.

**Projections and Datum:** Illinois State Plane Coordinate System, East and West zones; and Transverse Mercator, UTM grid zones 15 and 16; NAD 83 datum.

**Spatial Resolution:** 1.5 x 1.5 foot ground sample distance per pixel for the SPCS orthoimagery, and 0.5 x 0.5 meter ground sample distance per pixel for the UTM orthoimagery.

**Data Format:** GeoTIFF with accompanying FGDC-compliant metadata.

**Data Files:** Each image file will conform to the USGS 3.75' x 3.75' Digital Orthophoto Quarter Quadrangle (DOQQ) standard. Estimated number of DOQQ image files is 3,250 and file size is approximately 175 Mb for each DOQQ.

### **Funding Partners:**

U.S. Geological Survey  
USDA Natural Resources Conservation Service  
Federal Emergency Management Agency  
National Geospatial-Intelligence Agency  
Illinois Department of Transportation  
Illinois Emergency Management Agency  
Illinois Environmental Protection Agency  
Illinois Department of Revenue  
Illinois Historical Preservation Agency  
Northeastern Illinois Planning Commission  
Chicago Area Transportation Study  
The Counties of Cook, DuPage, Kane, Lake, McHenry



**National Research Program**  
**by**  
**Pierre D. Glynn, Chief of BRR/ER**

## **Mission and Structure of the National Research Program**

The National Research Program (NRP) in the hydrological sciences encompasses a broad spectrum of scientific investigations and focuses on long-term integrated studies related to water resource and environmental problems. The NRP provides an infrastructure within which the USGS can develop new information, theories, and techniques to understand, anticipate, and solve water-resource problems facing managers of Federal lands and the Nation. Detailed information on NRP projects, objectives, and publications can be obtained from the following Web site: <http://water.usgs.gov/nrp/>.

The NRP makes a deliberate effort to anticipate research needs that will be pertinent to hydrologic science issues of the future. New information, theories, techniques, and tools developed by scientists within the program are used by other USGS scientists and managers, by members of the hydrologic community outside the USGS, nationally and internationally, and by the public. The emphasis of NRP research activities changes through time, reflecting the emergence of needed new areas of inquiry and the demand for new tools and techniques with which to address water-resources issues and problems. The program is directly linked to and funded by other USGS programs and initiatives to ensure that NRP research addresses current water-resource needs. The NRP's staff of about 230 permanent and 80 non-permanent individuals is located principally at USGS centers in Reston, Virginia; Denver, Colorado; and Menlo Park, California. NRP Research can be subdivided into the following research areas, goals, and topics:

**Water Chemistry:** assess natural and contaminant chemicals in water and sediment, and study chemical and biochemical processes that affect the movement of solutes. Research topics include: Organics in aquatic systems, Carbon cycling and climate, Isotope hydrology and paleohydrology, Trace elements and radionuclides, Weathering and watershed processes, Transport and biogeochemical reactions, Gases in aquatic systems

**Ground-Water Hydrology:** understand the processes that control the transport and fate of subsurface water, solutes, microbes, particulates, and other fluid phases. Topics include: Development of quantitative ground-water models, Ground-water—surface water—atmospheric interactions, Unsaturated-zone hydrology, Fractured-rock hydrology, Ground water in geologic processes

**Surface-Water Hydrology:** quantify, understand, and model the physical processes that control the distribution and quality of surface-water resources. Topics include: Flow and transport in rivers, Watershed modeling, Estuarine hydrodynamics, Climate variability and surface-water hydrology, Statistical analysis of floods and droughts

**Geomorphology and Sediment Transport:** understand stream-channel morphology and erosional processes that govern the source, mobility, and deposition of sediment. Topics include: Sediment transport dynamics, Changes in river channels over time, Channel morphology and sediment transport, Flow and sediment mechanics,

**Ecology:** investigate ecological and biogeochemical processes that affect the quality of water in aquatic systems. Topics include: Microbiology, Aquatic Ecology, Climate and Ecology, Biogeochemistry

## **Examples of NRP Contributions**

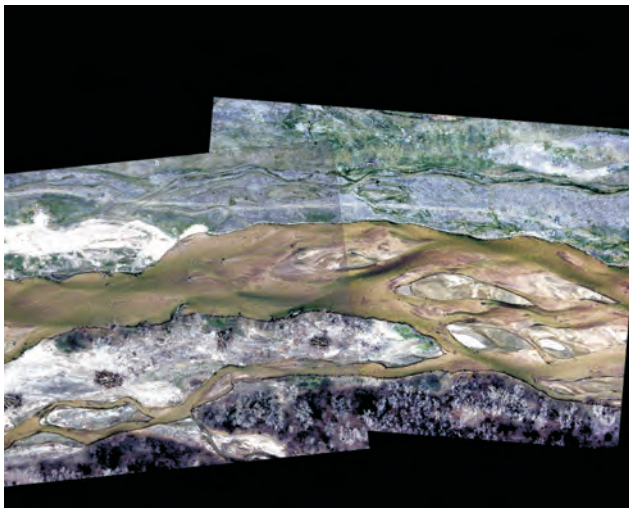
A few research contributions and advances that have come out from the NRP are listed below.

**Surface-water and sediment-transport modeling:** The Multi-Dimensional Surface Water Modeling System (MDSWMS) has recently been developed. MDSWMS (<http://internalbrr.cr.usgs.gov/~arburman/>) is a pre- and post-processing application for computational models of surface-water hydraulics. Two different modeling codes are currently incorporated in MDSWMS, the one-dimensional, pseudo-2D, FastMech code and the fully 2-D STORM code (still under development). The codes have been used in combination with a variety of field observations, (e.g., LIDAR, bathymetric mapping, infra-red delineation of roosting areas) to assess and predict bridge scour and transport of metal-contaminated sediments, and to assess the effects of stream flow and consequent sediment transport on the distribution and quantity of critical ecological habitats and species (e.g., sand-hill cranes, white sturgeon, riparian vegetation). Figure 1 provides an example for the Platte River sand-hill crane habitat, where vegetative resistance to flow, and the ensuing distribution of crane roosting areas on sand-bars, are critical issues.

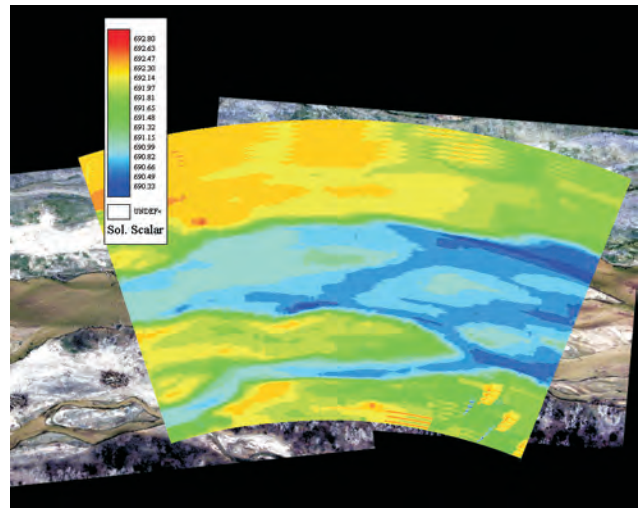
**Ground-water dating:** The Reston ground-water dating laboratory (<http://water.usgs.gov/lab/>) develops techniques to measure atmospheric tracers in ground-waters and uses the information to help determine ground-water residence times, flow rates and recharge ages. The measurements of very low level concentrations of volatile organic carbon compounds (at part per trillion levels) is also used to assess the susceptibility of aquifer resources to contamination problems. The project also encourages and coordinates the use of other ground-water dating techniques and tracer measurements such as those portrayed in the figure 2 (Plummer, 2005).

Ground-water residence times are often essential to determining the response times of watersheds to (1) changes in management practices, (2) to evolving anthropogenic effects, or (3) to changes in natural climatic variations. For example, the distribution of spring-water ages in the Chesapeake Bay watersheds (figure 3) shows that the response time to nutrient mitigation strategies, or to other natural or anthropogenic variations, may be lengthened because ground waters in the Bay watershed often have residence times on the order of 10 or more years.

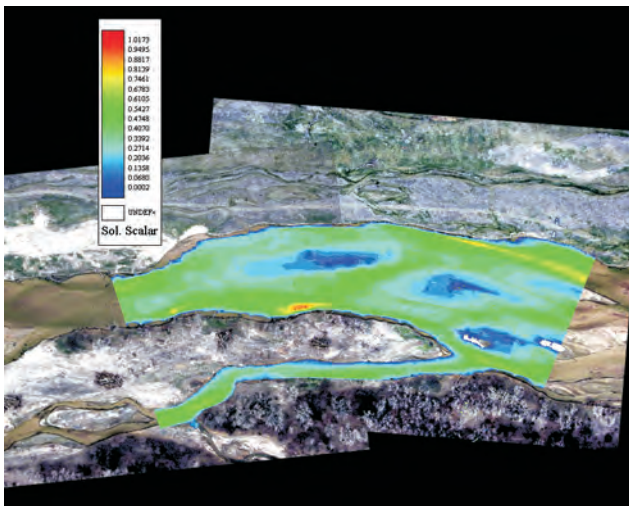
**Water-quality studies:** The NRP conducts laboratory, field and modeling investigations on a wide variety of water-quality issues, including natural and anthropogenic contaminants such as arsenic (<http://wwwbrr.cr.usgs.gov/Arsenic/>), mercury and methyl mercury, perchlorate, nutrients, pesticides and herbicides, pharmaceuticals



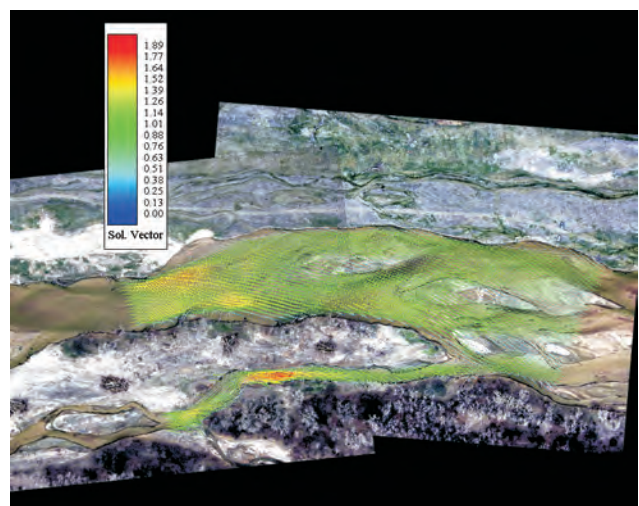
Aerial photograph of study site 3/2003



MD\_SWMS topographic surface



MS\_SWMS computed depths (38 m<sup>3</sup>/s)



MD\_SWMS computed velocity vectors (38 m<sup>3</sup>/s)

Figure 1. The use of multidimensional flow and sediment-transport models assists in the understanding of potential channel changes in the Platte River that result from stream flow and manipulation of vegetation on islands and banks. Surveys of topography and grain-size distributions will be done to predict local sediment rating curves and critical flows for initiation of motion for grain sizes in both main and secondary flow channels. For a variety of real and hypothetical flow-discharge scenarios, model results will be used to make preliminary assessments of the role of stormflow in maintaining or modifying channel and bank morphology. In addition, velocity and bottom stress maps of the critical reach will be compared to vegetation patterns to assess the roles of various flows in promoting or discouraging certain types of riparian vegetation.

and personal care products, radionuclides, and other organic and inorganic contaminants. Site studies encompass a full range of environments (ground waters, lakes, estuaries, streams and rivers, permafrost and ice). Some of the most interesting studies investigate processes at the interface of different environments. In particular, ground-water/surface-water interactions and their effects on water quality are a leading edge of NRP research (<http://water.usgs.gov/nrp/jharvey/site/index.html>). Figure 4 (Schuster et al, ES&T, 2002) shows the historical record of atmospheric mercury, as found trapped in an ice core from the Fremont glacier in Wyoming.

**Climate modeling and understanding global shifts in water availability:** The NRP seeks to understand and document climate (and hydrologic) variability, its spatial and temporal patterns and descriptive statistics, and potentially its causes. Research

is conducted to assess flood and drought occurrences, and their associated ecological and environmental effects, on historical and geological time-scales. For example, NRP research has shown (Gray et al, 2003) how the occurrence of severe prolonged droughts during the 20<sup>th</sup> century may be correlated with variations in sea surface temperatures of the tropical Pacific and the North Atlantic Oceans.

**Microbiology:** NRP microbiologists (e.g., <http://water.usgs.gov/nrp/proj.bib/microbiology/index.html>) investigate DNR/RNA characterization techniques that could improve bacterial source tracking, and study the occurrence and transport of a variety of microorganisms and pathogens in the natural environment. For example, work is on-going on the distribution of *Helicobacter pylori*, a bacterium that affects human health, and on the distribution of the Chytrid Fungus, an organism thought to be one of the factors

potentially responsible for the growing disappearance of amphibian species.

### Conclusions

The NRP seeks to serve the public by developing new measurement or modeling techniques, by conducting fundamental research on natural processes, and by applying it's leading-edge investigative capabilities at sites across the US (and occasionally in foreign countries). Active collaboration with other USGS units, especially USGS Water Science Centers, and other Federal and State agencies, is key to helping ensure the present, and future, societal relevance of NRP research.

Plummer, 2005  
 Schuster et al, ES&T, 2002  
 Gray et al, 2003

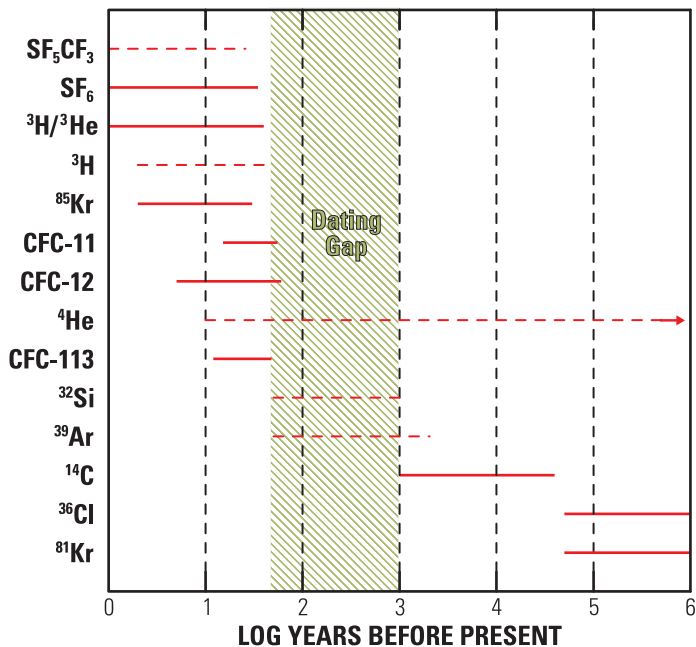


Figure 2. Approximate Range of Dating Applications

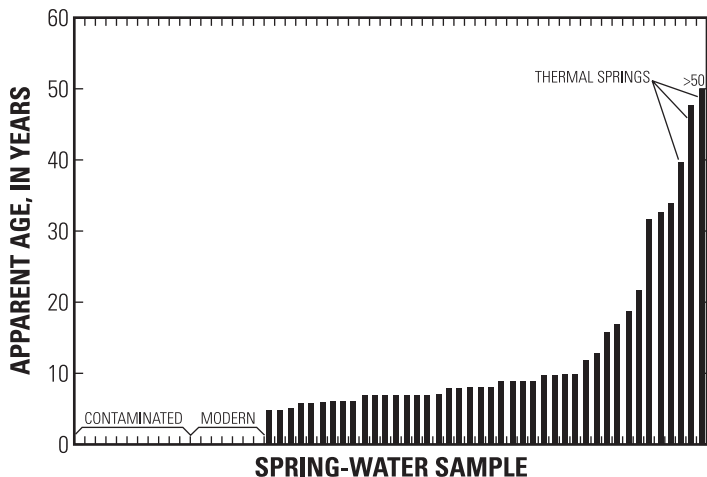


Figure 3. Apparent ages (residence time) of water collected from springs in the Chesapeake Bay Watershed in September and November 1996 (from Focazio and others, 1998).

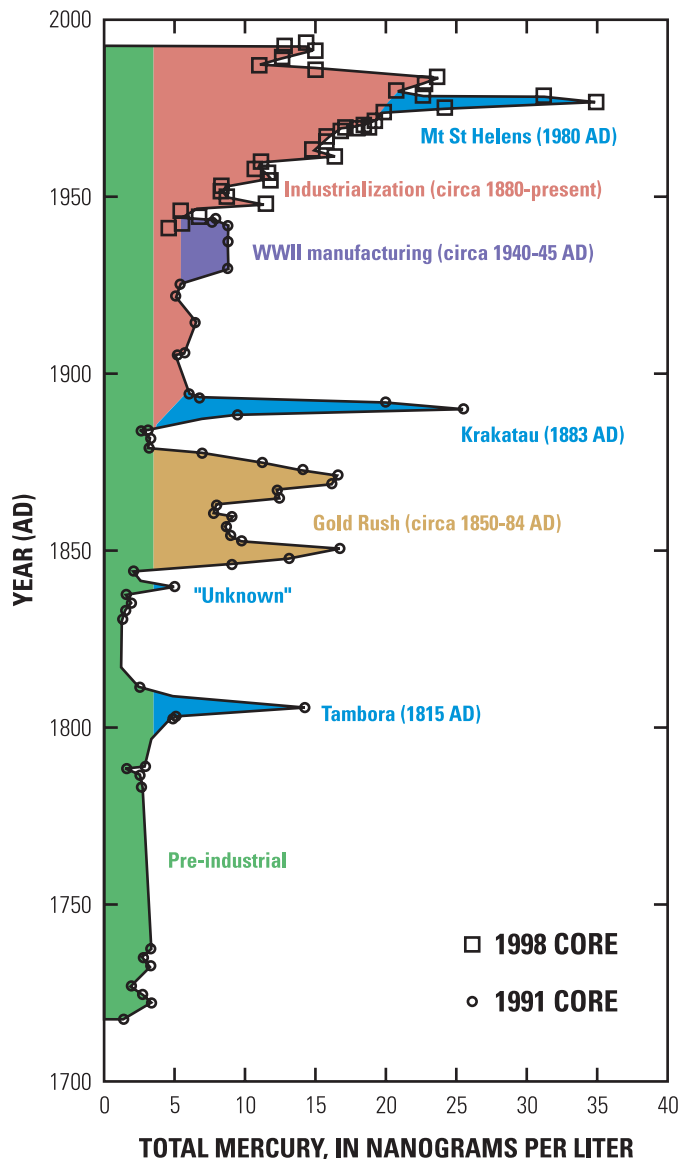
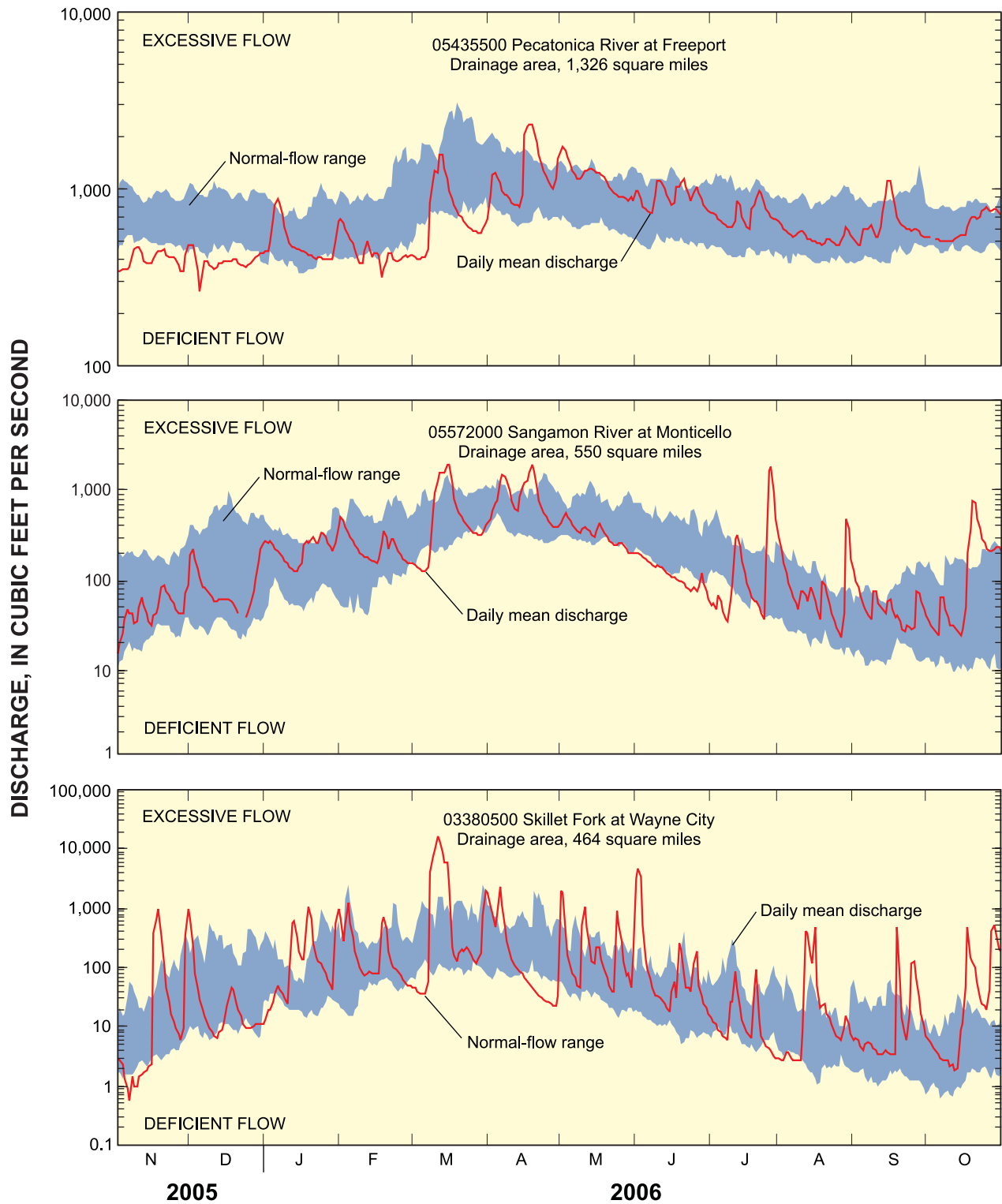


Figure 4. Historic record of atmospheric mercury from ice core samples.



# Illinois Streamflow Conditions for November 2005 Through October 2006



Daily mean discharge from November 1, 2005 through October 30, 2006 compared with percentile distribution of mean daily discharged for the 30-year period, 1961-90, for 3 representative streamgaging stations. A daily mean discharge is in the deficient-flow if its value is less than or equal to the 25<sup>th</sup> percentile, in the normal-flow range if its value is between 25<sup>th</sup> and 75<sup>th</sup> percentiles, and in the excessive-flow range if its value is equal to or greater than the 75<sup>th</sup> percentile.

Listed below are publications that were published recently. Federal Fiscal Year (FY) covers October 1 through September 30. Our policy is to provide copies of our publications to requestors at no cost as long as the publication is in stock in the USGS Illinois Water Science Center. To obtain copies of the following, or any other USGS Illinois Water Science Center publication, you may contact Donna Ayers at (217) 344-0037, extension 3053 or by e-mail at [dmayers@usgs.gov](mailto:dmayers@usgs.gov).

Reports also can be found at:

<http://il.water.usgs.gov/pubs/search.html>.

**FY 2006**

SIR 2006-5016, Suspended-Sediment Yields and Stream Channel Processes on Judy's Branch Watershed in the St. Louis Metro East Region in Illinois, by T.D. Straub, G.P. Johnson, D.P. Roseboom, and C.R. Sierra. (<http://pubs.usgs.gov/sir/2006/5016/>)

SIR 2006-5018, Computation of Discharge and Error Analysis for the Lake Michigan Diversion Project in Illinois, by J.J. Duncker, T.M. Over, and J.A. Gonzalez. (<http://pubs.water.usgs.gov/sir/2006/5018/>)

SIR 2006-5076, Hydrogeology, Water Use, and Simulated Ground-Water Flow and Availability in Campton Township, Kane County, Illinois, by R.T. Kay, L.D. Arihood, T.L. Arnold, and K.K. Fowler. (Web only at <http://pubs.usgs.gov/sir/2006/5076/>)

SIR 2006-5078, Concentrations, Fluxes, and Yield of Nitrogen, Phosphorus, and Suspended Sediment in the Illinois River Basin, 1996-2000, by P.J. Terrio. (<http://pubs.water.usgs.gov/sir/2006/5078/>)

SIR 2006-5158, Sediment Coring and Sediment Analysis on Rasmussen Lake in Ethel's Woods Forest Preserve Old Mill Creek, Illinois. by T.D. Straub, D.P. Roseboom, and P.G. Dennis. (Web only at <http://pubs.water.usgs.gov/sir/2006/5158/>)

OFR 2006-1045, Geology, Hydrology, and Water Quality in the Vicinity of a Brownfield Site near Yorkville, Illinois, by R.T. Kay. (Web only at <http://pubs.usgs.gov/of/2006/1045/>)

OFR 2006-1430, Sensitivity of Potential Evapotranspiration and Simulated Flow to Varying Meteorological Inputs, Salt Creek Watershed, DuPage County, Illinois, by D. Whitbeck. (<http://pubs.usgs.gov/of/2005/1430/>)



Pictured from left to right: Donald R. Vonnahme, IDNR-OWR Director (Retired); Gary P. Johnson, USGS Illinois Water Science Center Hydrologic Data Collection and Analysis Section Chief; Gary R. Clark, IDNR-OWR Director; Mark Myers, USGS Director; Melvin Allison, IDNR-OWR Planning Section Chief (Retired); Arlan R. Juhl, IDNR-OWR Planning Section Chief; Robert M. Hirsch, USGS Associate Director for Water; Robert R. Holmes, Jr., USGS Illinois Water Science Center Director.