serving water needs

USGS Monitoring to Meet Fresh Water Needs, Now and into the Future

Bill Werkheiser,
Associate Director for Water
August 6, 2014

USGS

Monitoring - A USGS priority because we can't manage what we don't measure.

USGS

Foundational Characteristics of USGS Monitoring

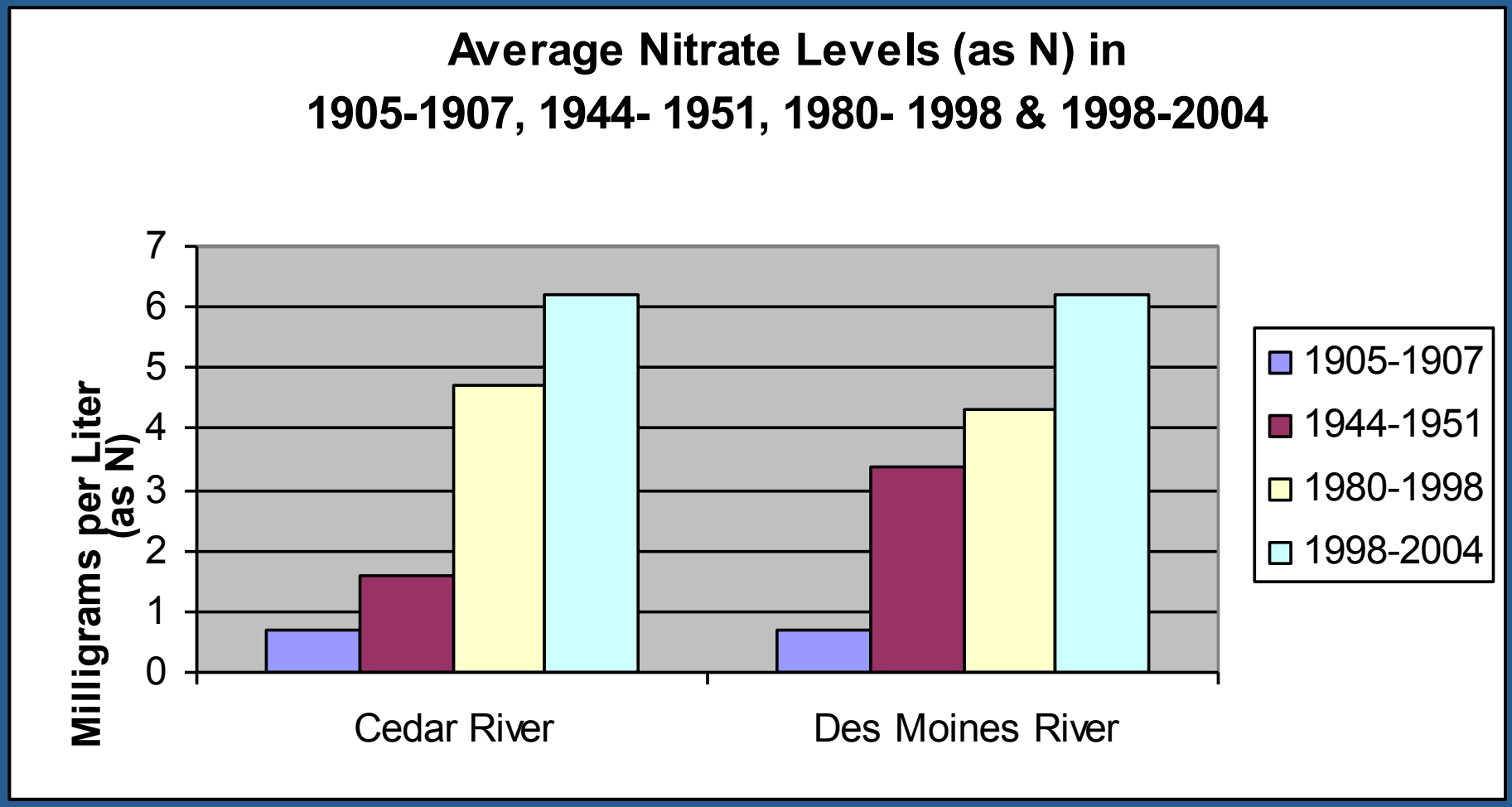
- **Long-term commitment**
- **Total resource for hydrologic context**
- **Interdisciplinary**
- **Rigorous and consistent methods**

USGS

Innovation for Looking Ahead

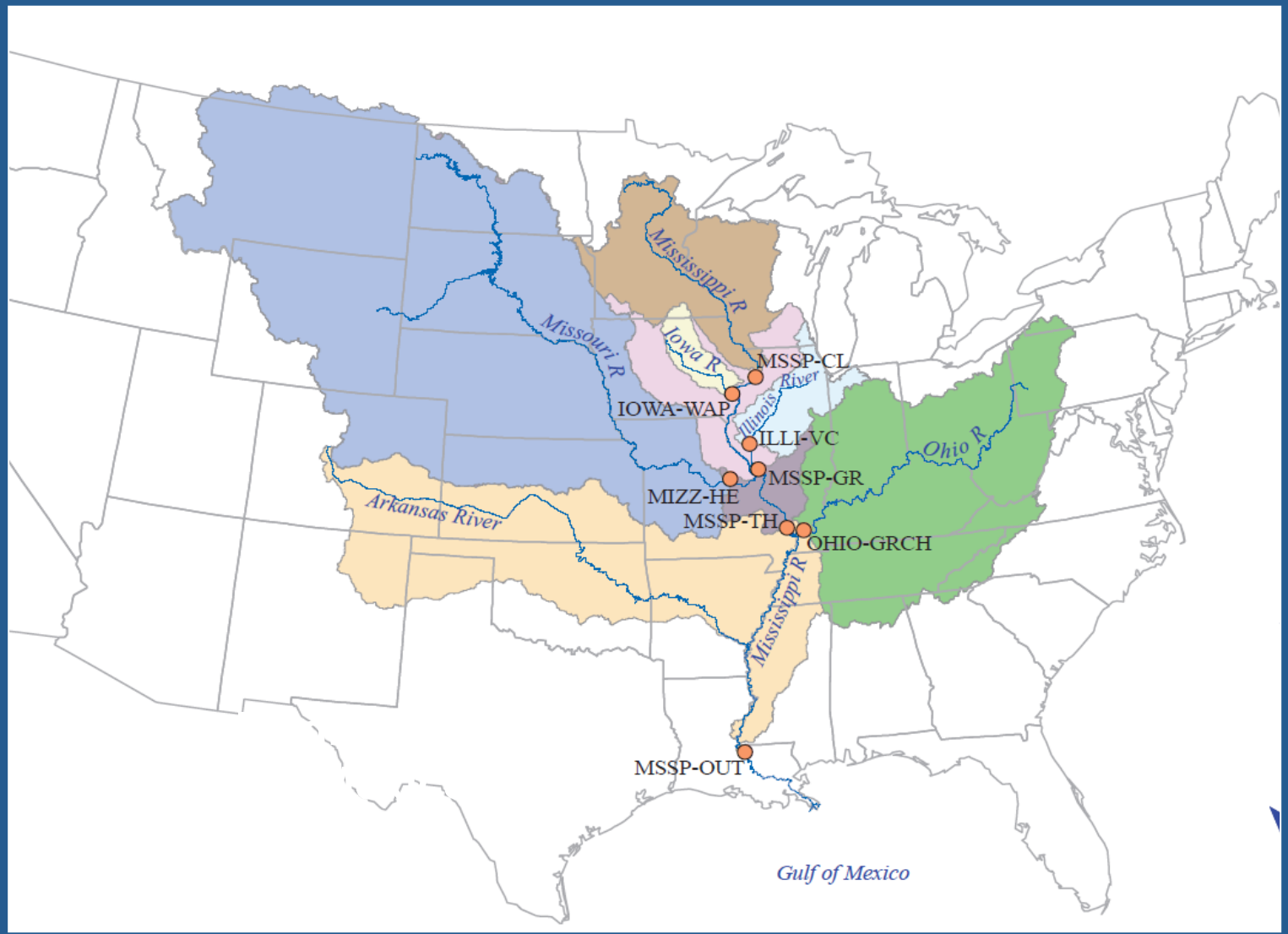
- **“Real time” monitoring**
- **Efficient and cost effective field monitoring technologies**
- **New laboratory methods for tracers and emerging contaminants at low levels of detection**
- **Monitoring to modeling for prediction and forecasting**
- **Enhanced data delivery and partnerships**

100-year Trends in Nitrate Concentrations in Two Iowa Streams



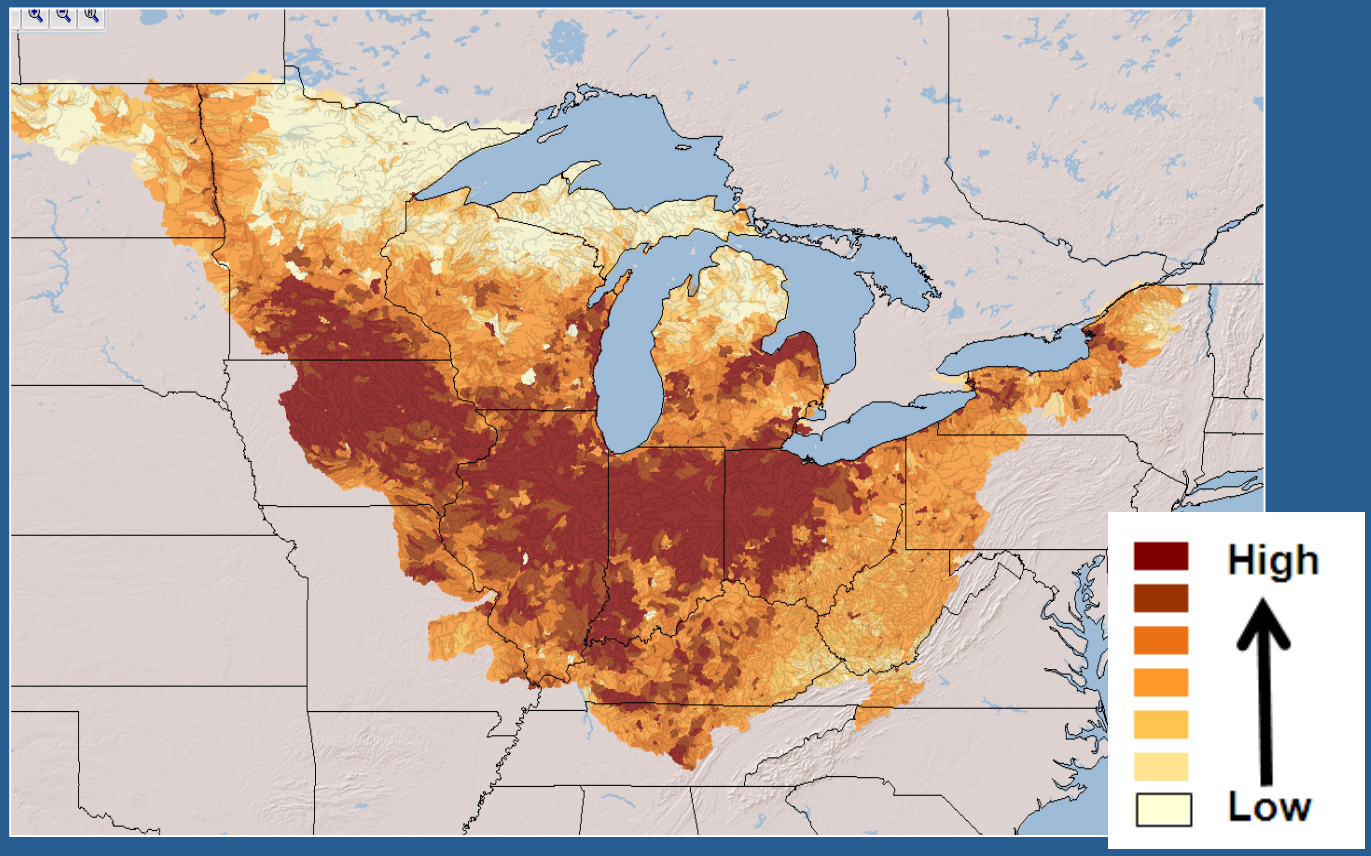
USGS

Nitrate trends evaluated from 1980 to 2010 at 8 long-term USGS monitoring sites in the Mississippi River Basin



USGS

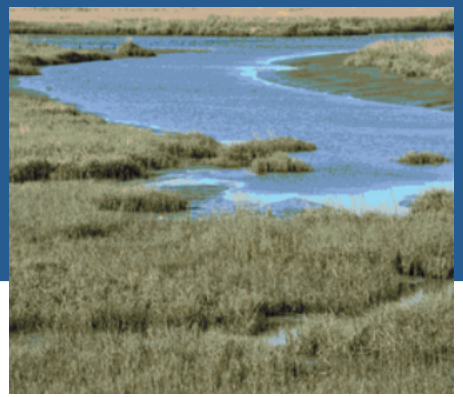
Modeled Nitrogen Yields in the Midwest (SPARROW)

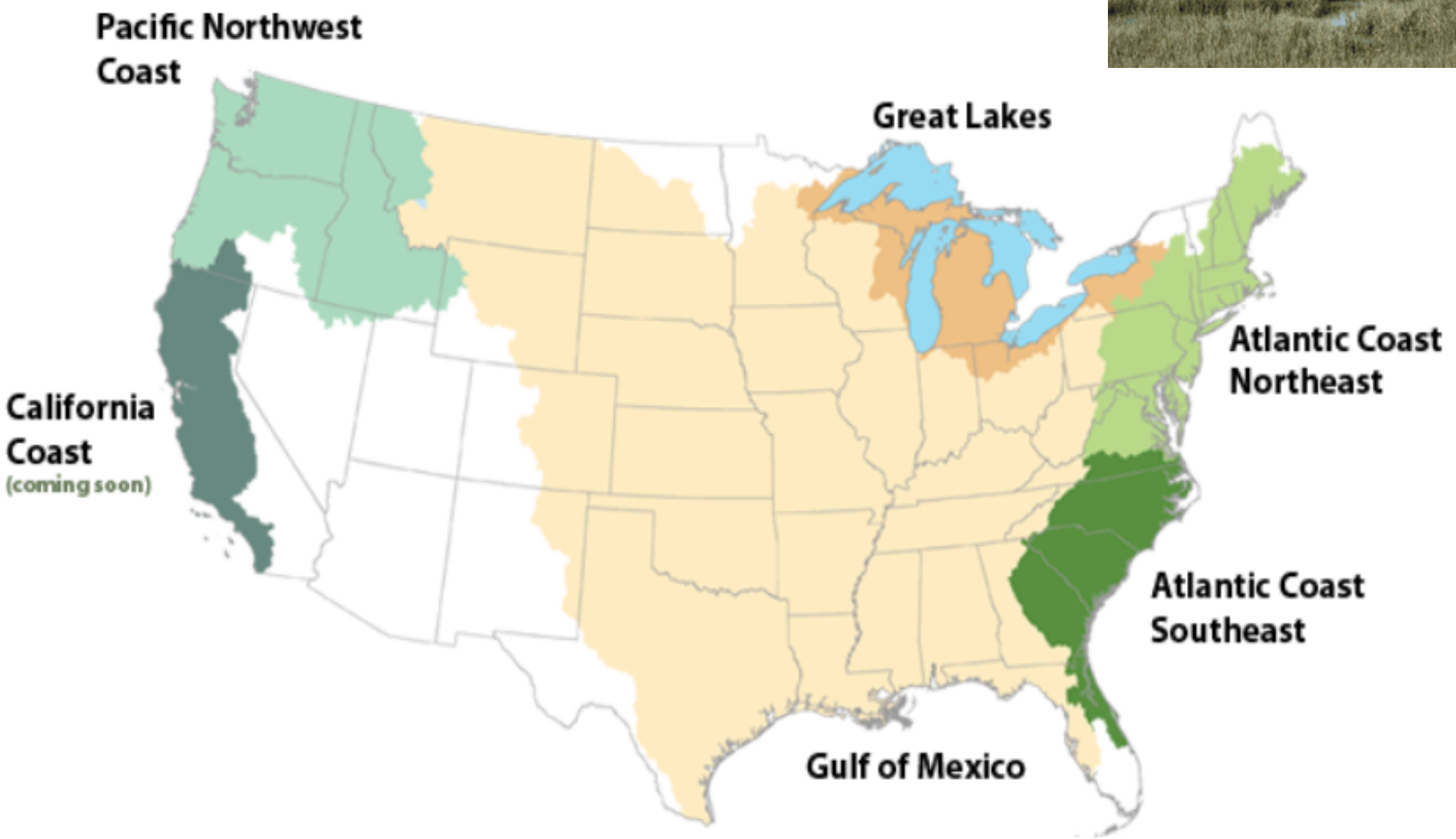


Investments in USGS water-quality monitoring *and* modeling foster capabilities to predict and forecast contaminant occurrence and trends under multiple scenarios at nationally significant scales.

USGS

Tracking the Source and Quantity of Nutrients to the Nation's Estuaries

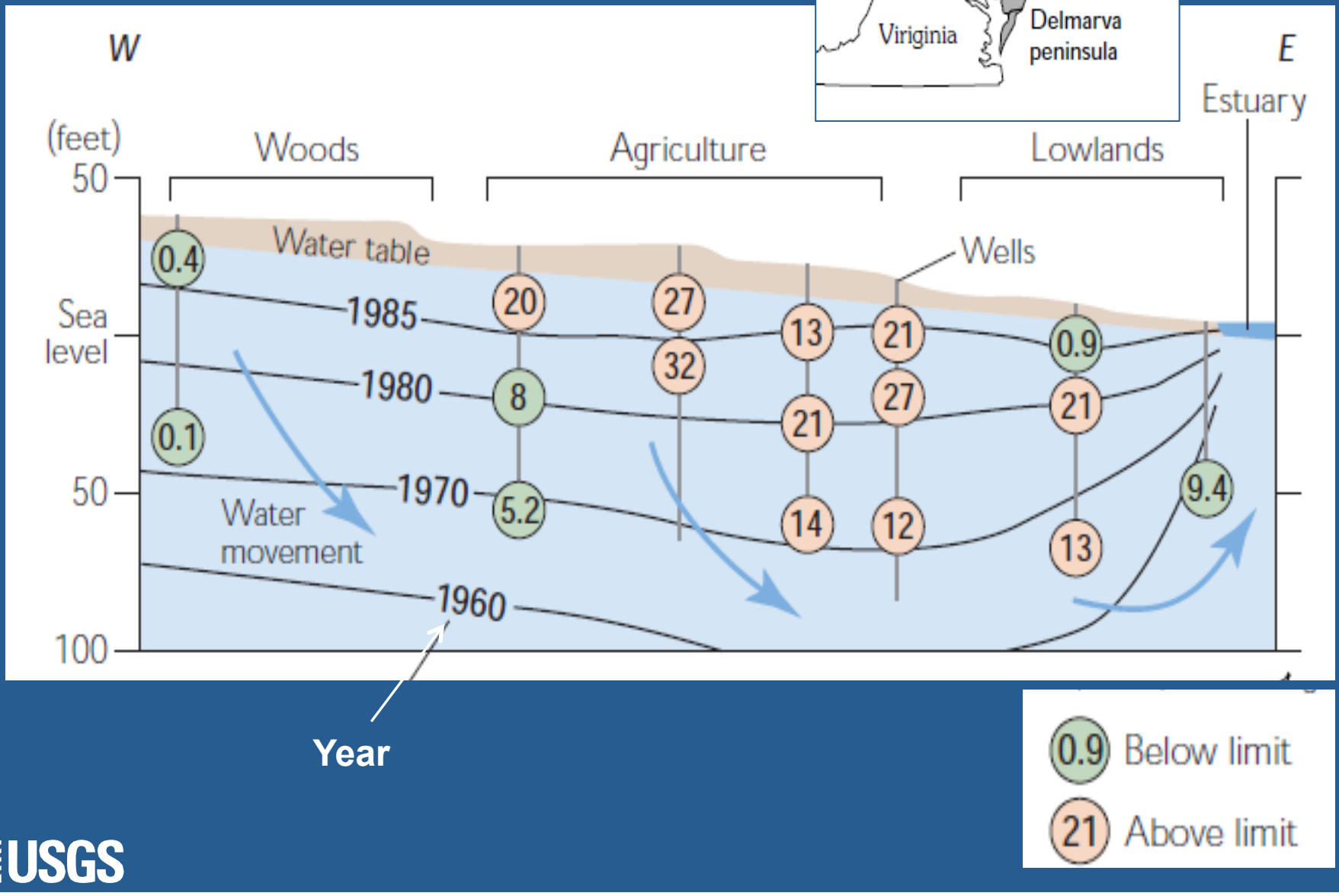




http://cida.usgs.gov/sparrow/

USGS

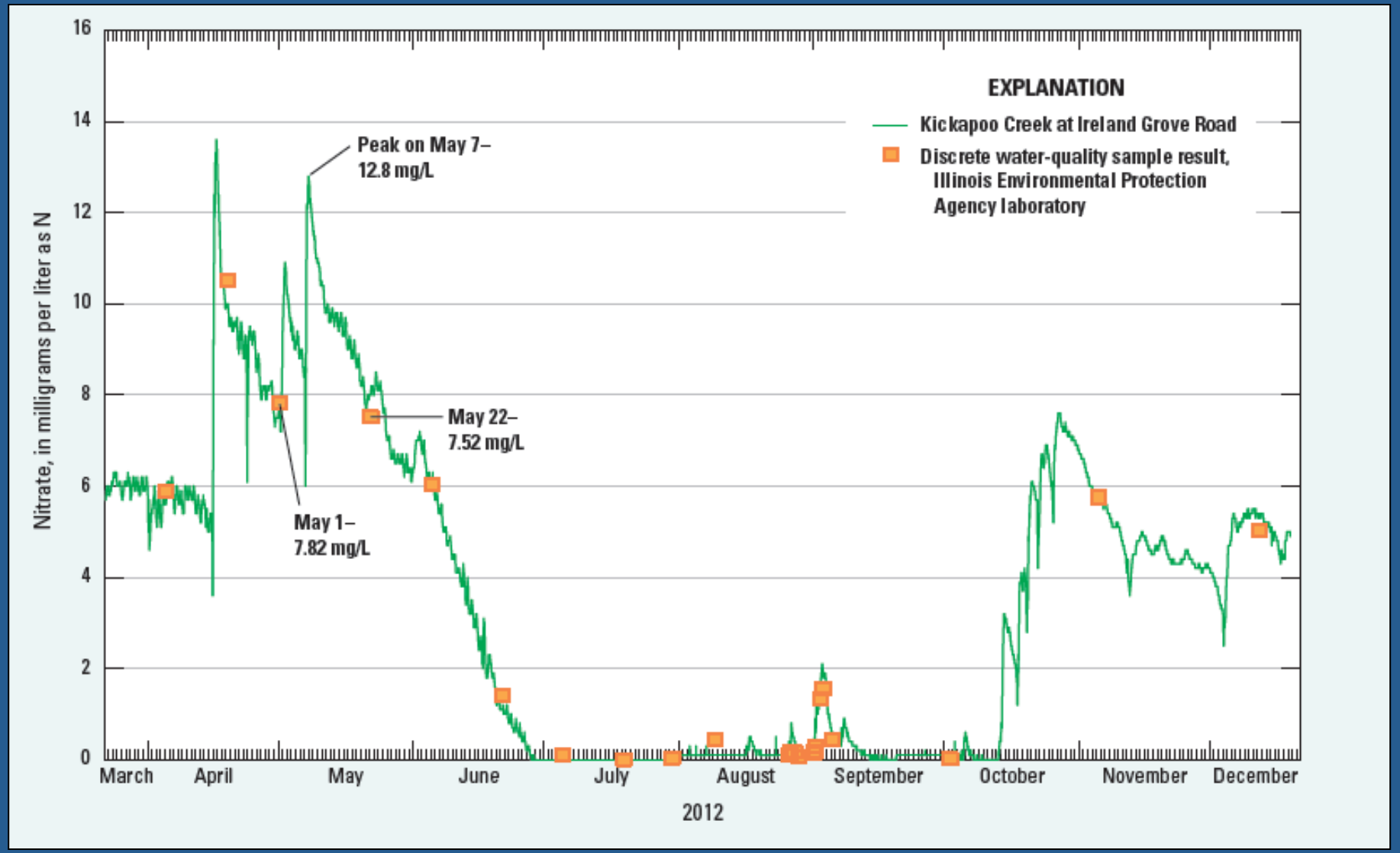
Age Dating to Monitor Nitrate in Groundwater Discharging to Streams and Estuaries



USGS

Real Time Nitrate Sensors

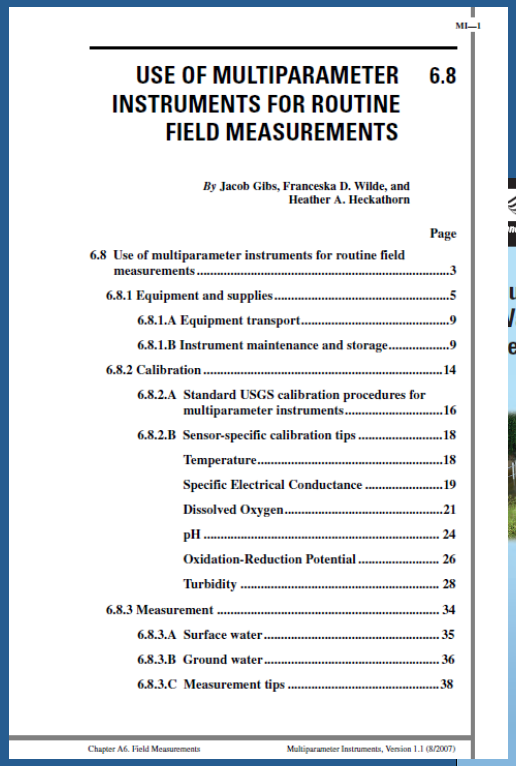
USGS



Continuous monitoring for nitrate at Kickapoo Creek near Bloomington, Illinois improve management of nitrate in drinking-water supplies

USGS

Common Guidelines and Protocols for Real-Time Monitoring



MI—1

USE OF MULTIPARAMETER INSTRUMENTS FOR ROUTINE FIELD MEASUREMENTS 6.8

By Jacob Gibs, Franceska D. Wilde, and Heather A. Heckathorn

Page

USGS
science for a changing world

Guidelines and Procedures for Computing Time-Series Suspended-Sediment Concentrations and Loads from In-Stream Turbidity-Sensor and Streamflow Data

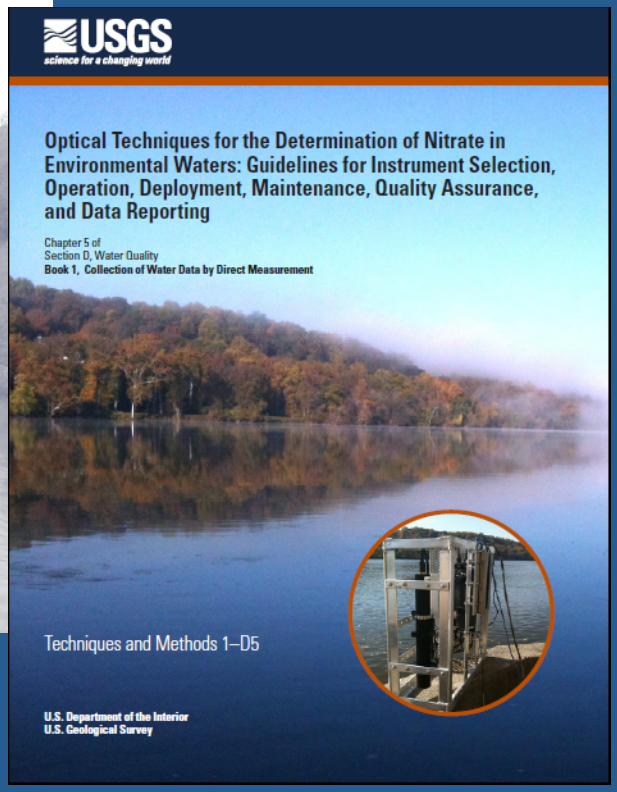
Chapter 4 of
Book 3, Applications of Hydraulics
Section C, Sediment and Erosion Techniques

USGS
nce for a changing world

uidelines and Standard Procedures for Continuous Vater-Quality Monitors: Station Operation, ecord Computation, and Data Reporting

Techniques and Methods 1–D3

U.S. Department of the Interior
U.S. Geological Survey



USGS
science for a changing world

Optical Techniques for the Determination of Nitrate in Environmental Waters: Guidelines for Instrument Selection, Operation, Deployment, Maintenance, Quality Assurance, and Data Reporting

Chapter 5 of
Section D, Water Quality
Book 1, Collection of Water Data by Direct Measurement

Techniques and Methods 1–D5

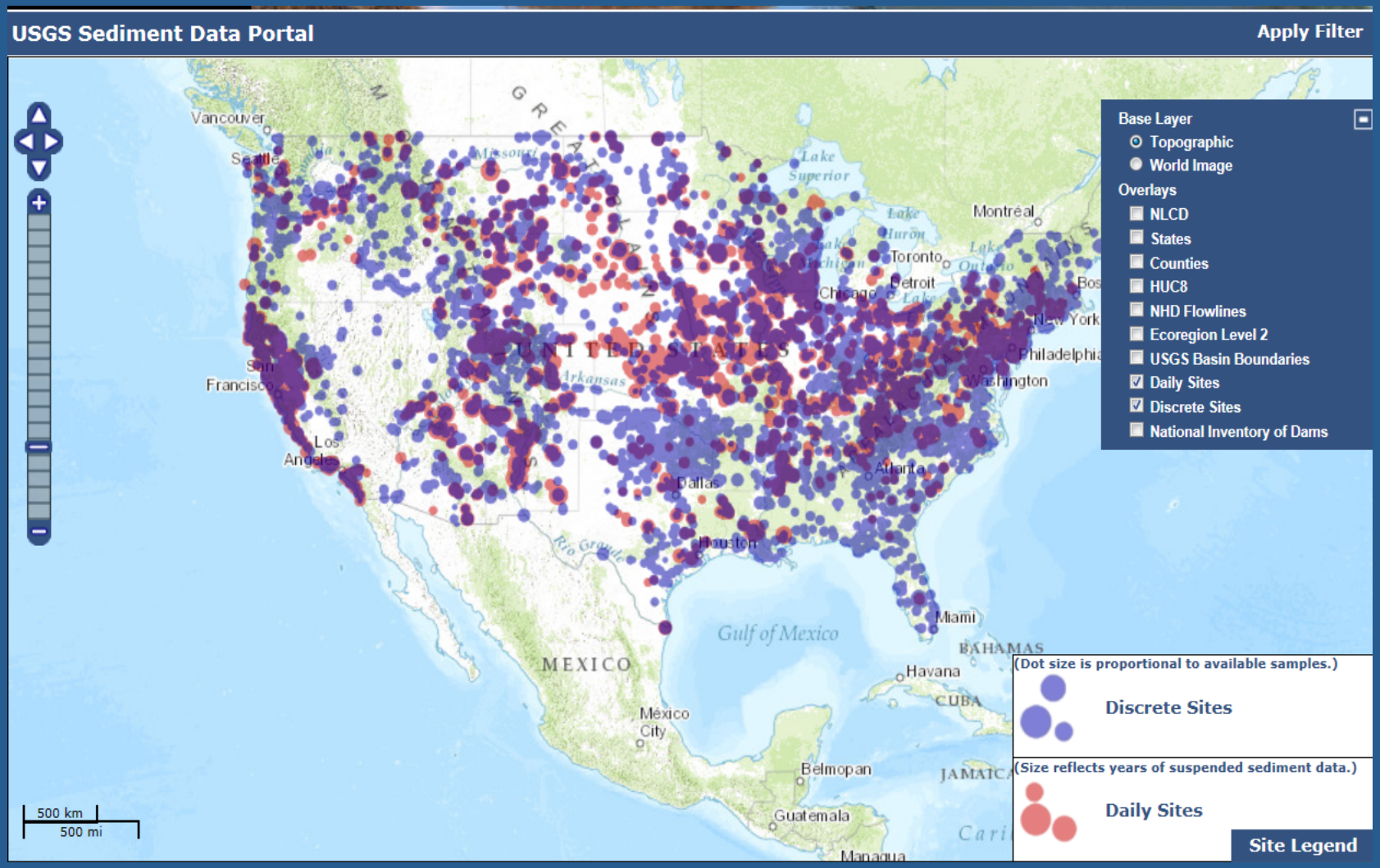
U.S. Department of the Interior
U.S. Geological Survey

USGS

- Sediment is associated with 10 of the 13 most common stream impairments (EPA 303d listing, 01/24/14)
- Damages from sediment-related impairments in North America total >$20 Billion annually (Science, V.267, pp. 1117-1123)

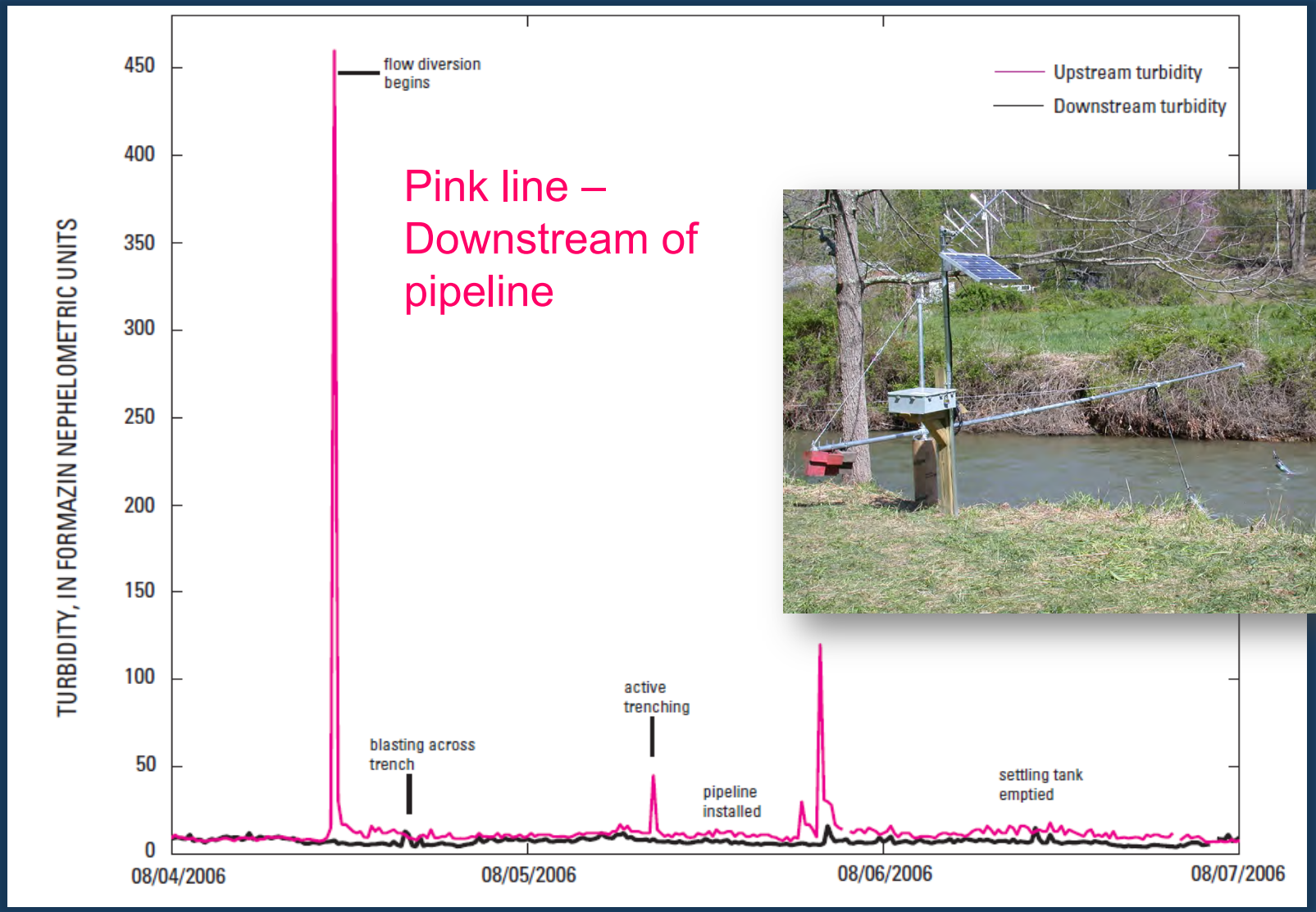
USGS

New USGS Data Portal Provides Access to More than a Century of Sediment Data



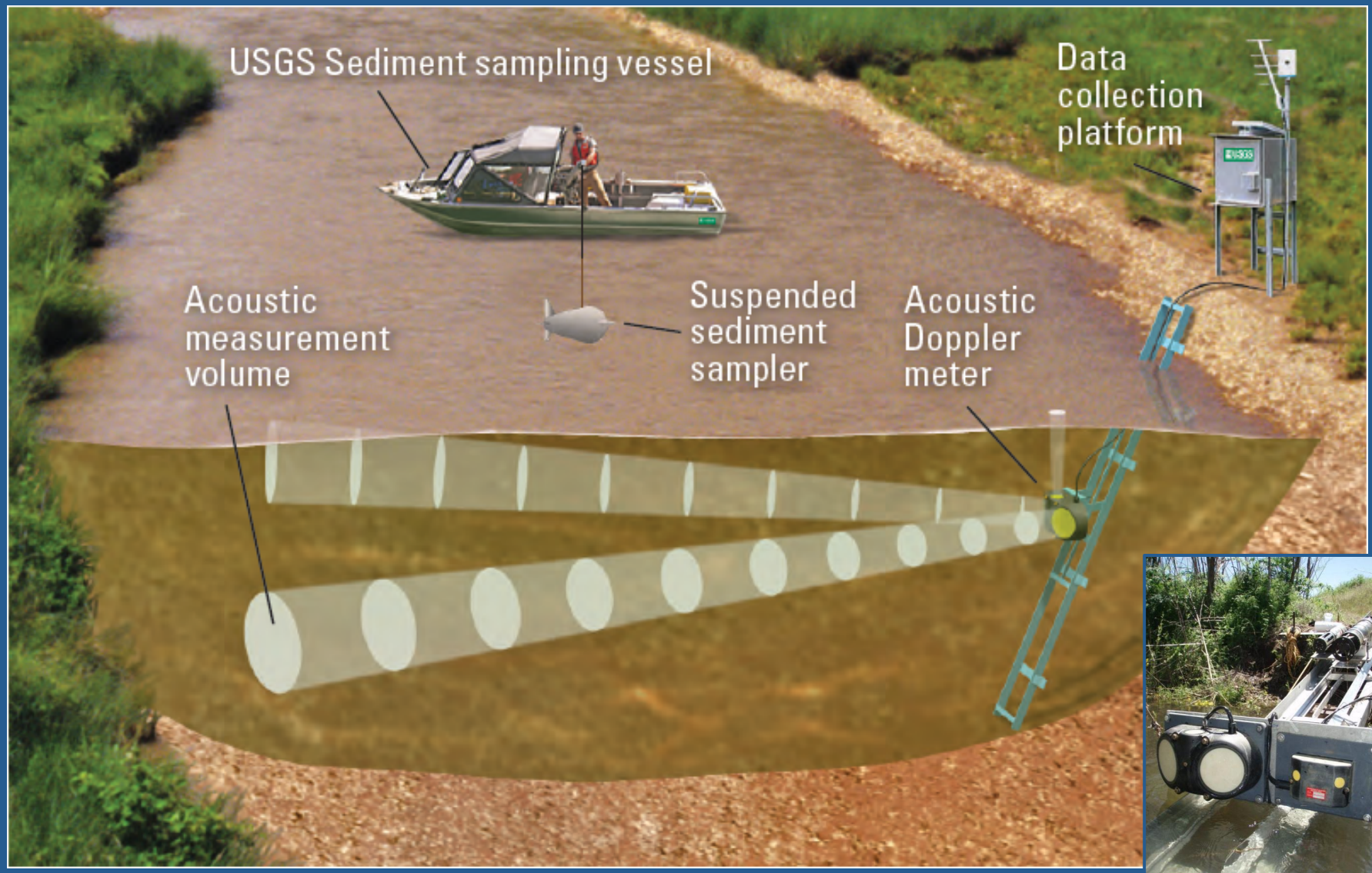
USGS

Realtime water-quality warning systems to protect endangered species in Tazewell, Virginia



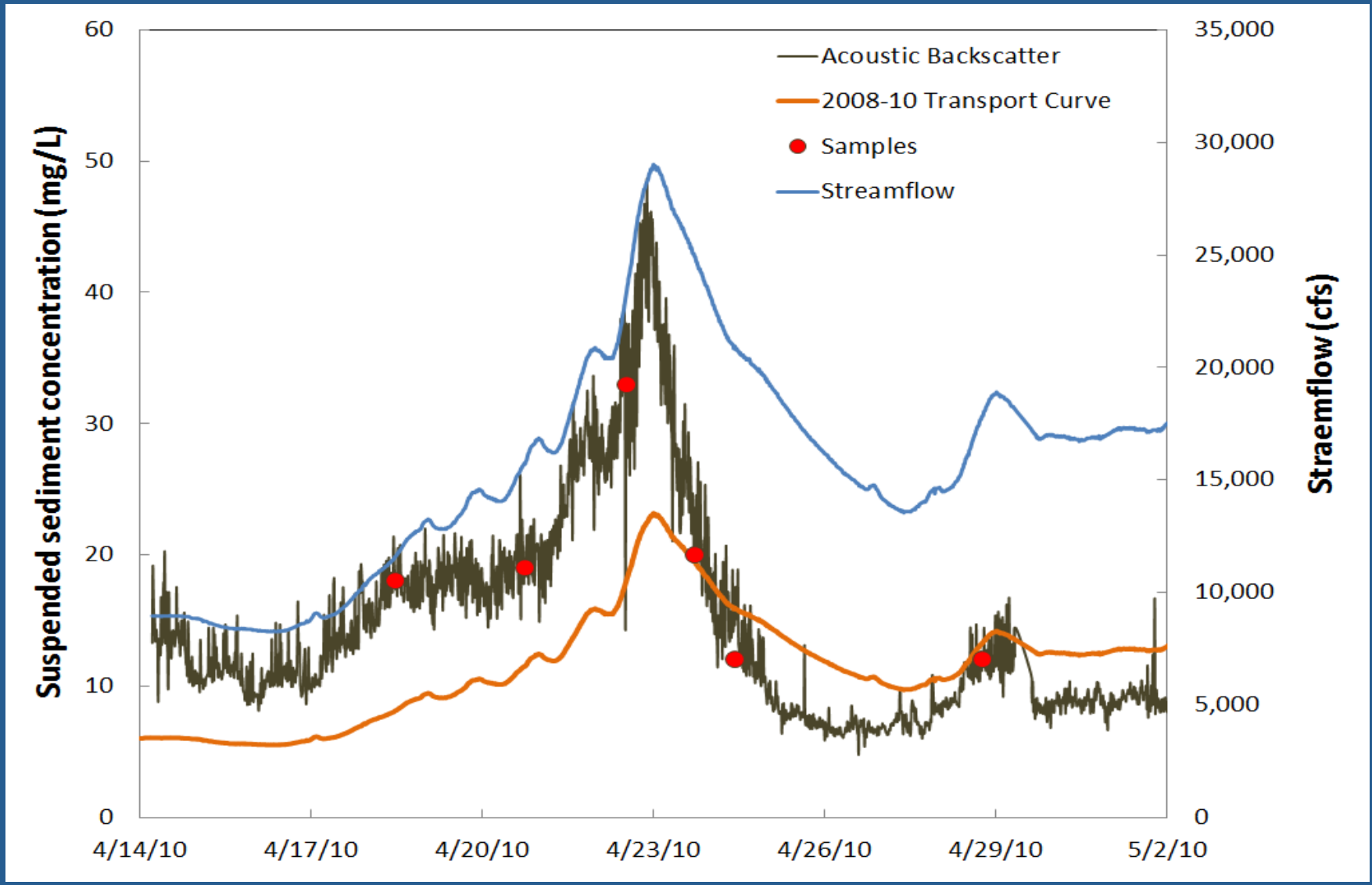
USGS

Using Acoustics to Measure Sediment



USGS

Estimated Sediment Concentrations using acoustic instruments in Clearwater River, Idaho



USGS

Pesticides remain a concern for human use and ecosystem health

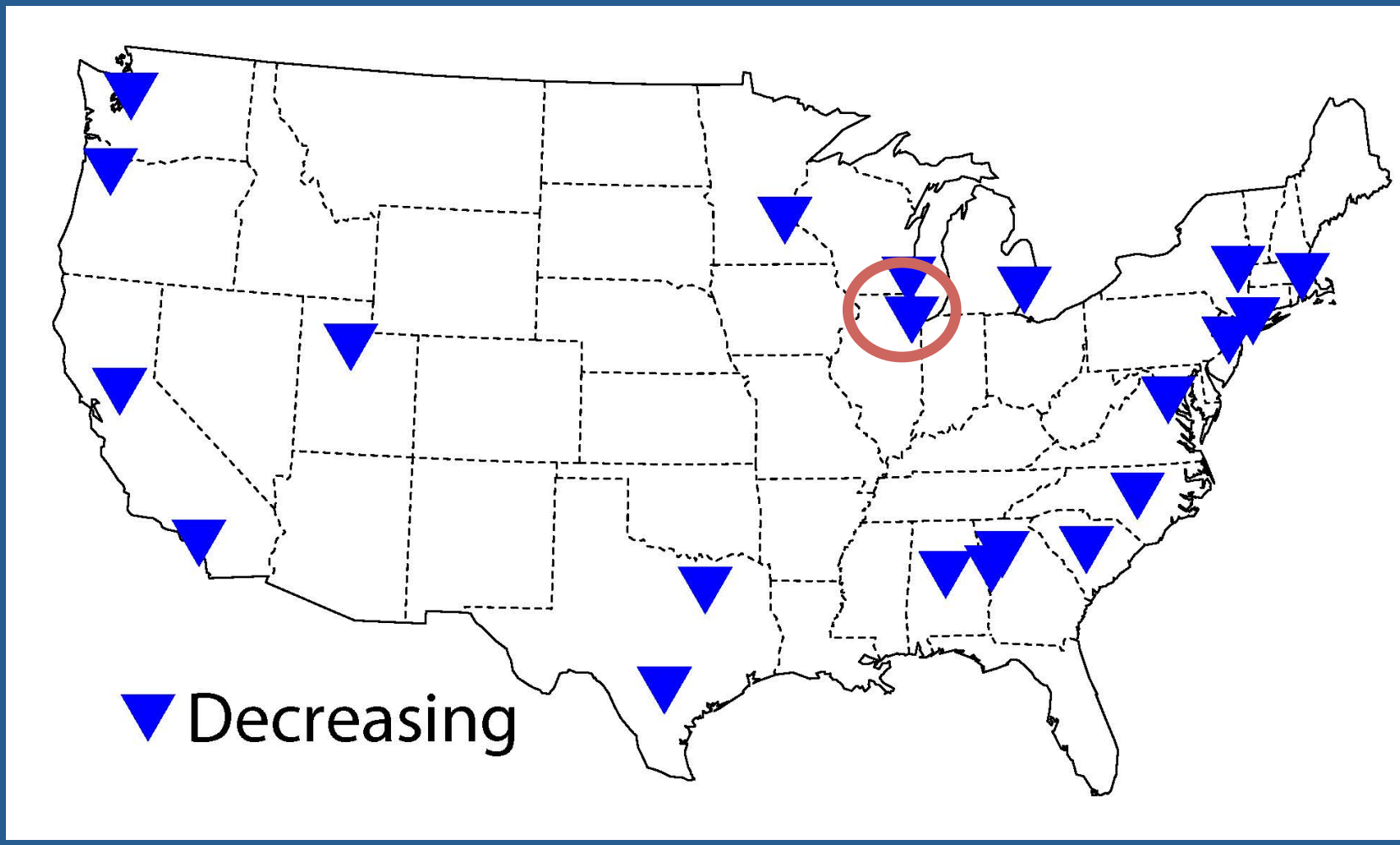
- Eighty percent of streams in urban areas have at least one pesticide the exceeded criteria to protect aquatic life.
- Of our public and domestic wells, which serve 150 million people, more than 20 percent contain at least one contaminant at levels of potential health concern.

USGS

Trends in Pesticide Concentrations in Urban Streams in the U.S.

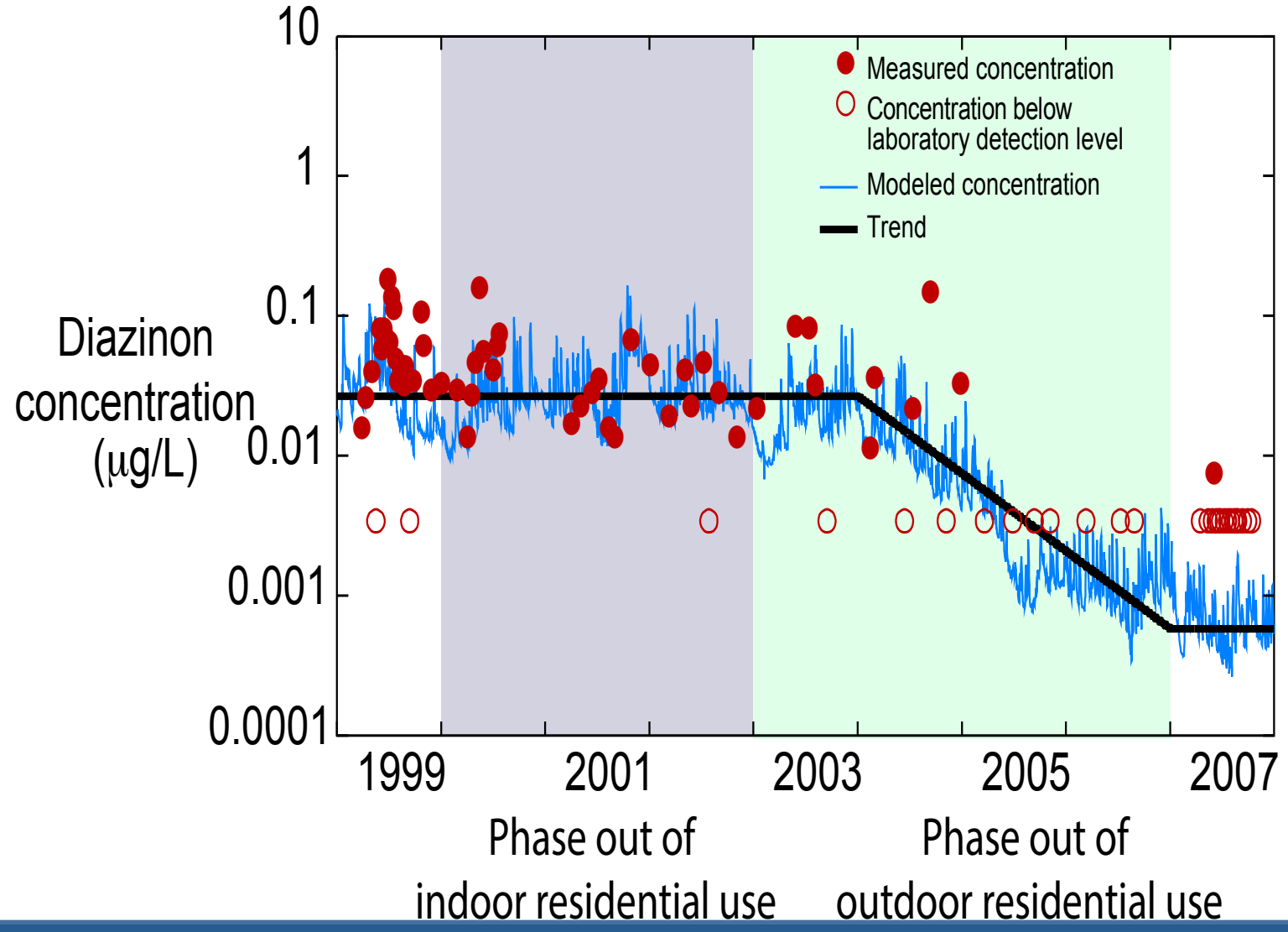
USGS

Diazinon Trends in Urban Streams
2000 - 2008



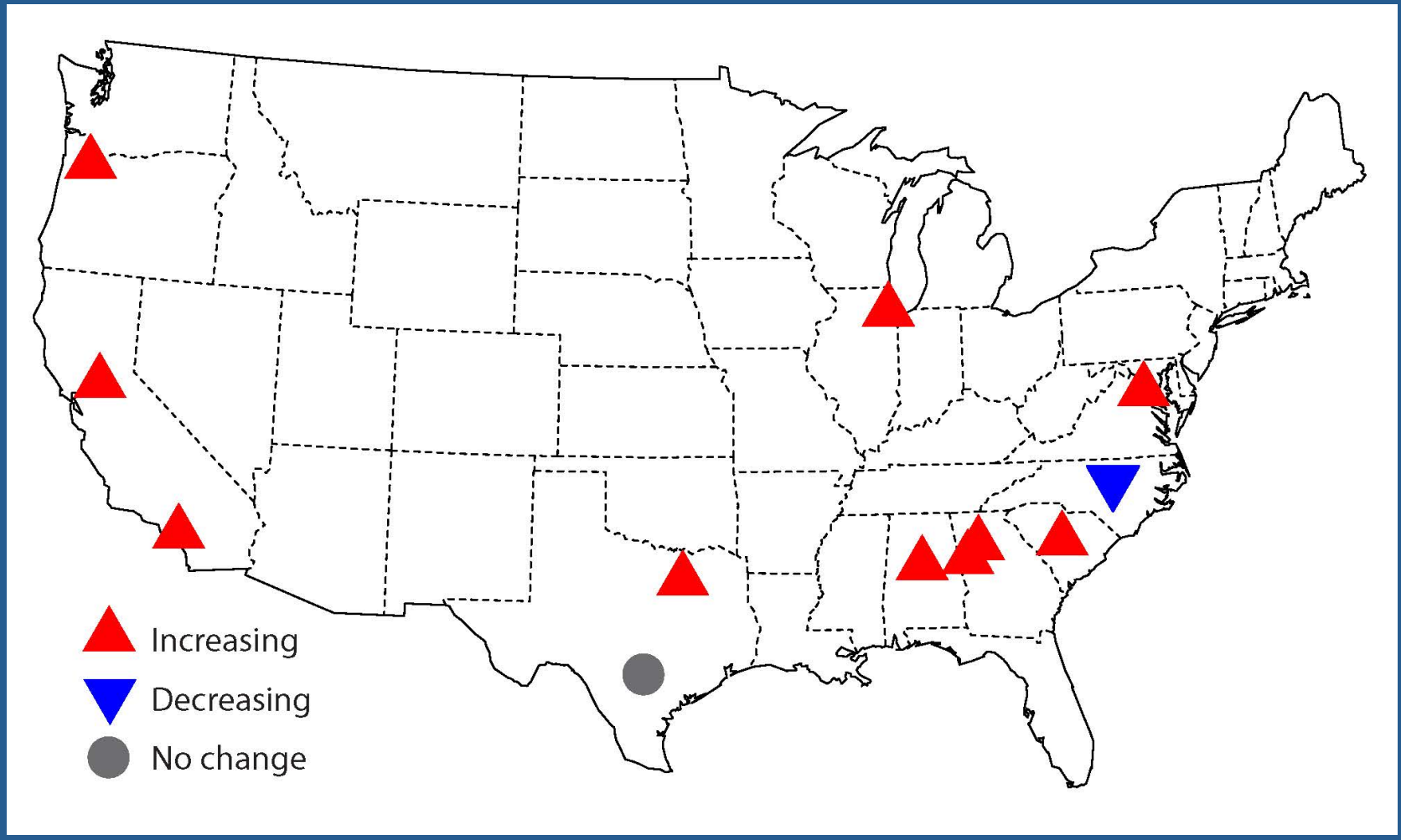
USGS

Diazinon Trends in Salt Creek, IL, 2000 - 2008



USGS

Fipronil Trends in Urban Streams
2000 - 2008



USGS

Glyphosate in the U.S.

- Use increased from less than 5,000 to 80,000 metric tons per year between 1987 and 2007
- Popular in agricultural and urban settings
- Largest compilation conducted to date, summarizing 3,700 water and sediment samples from 38 states
- Frequently detected in soil, sediment, ditches, drains, streams, rivers
- Concentrations generally less than levels of concern for humans or wildlife; however, most often found in mixtures

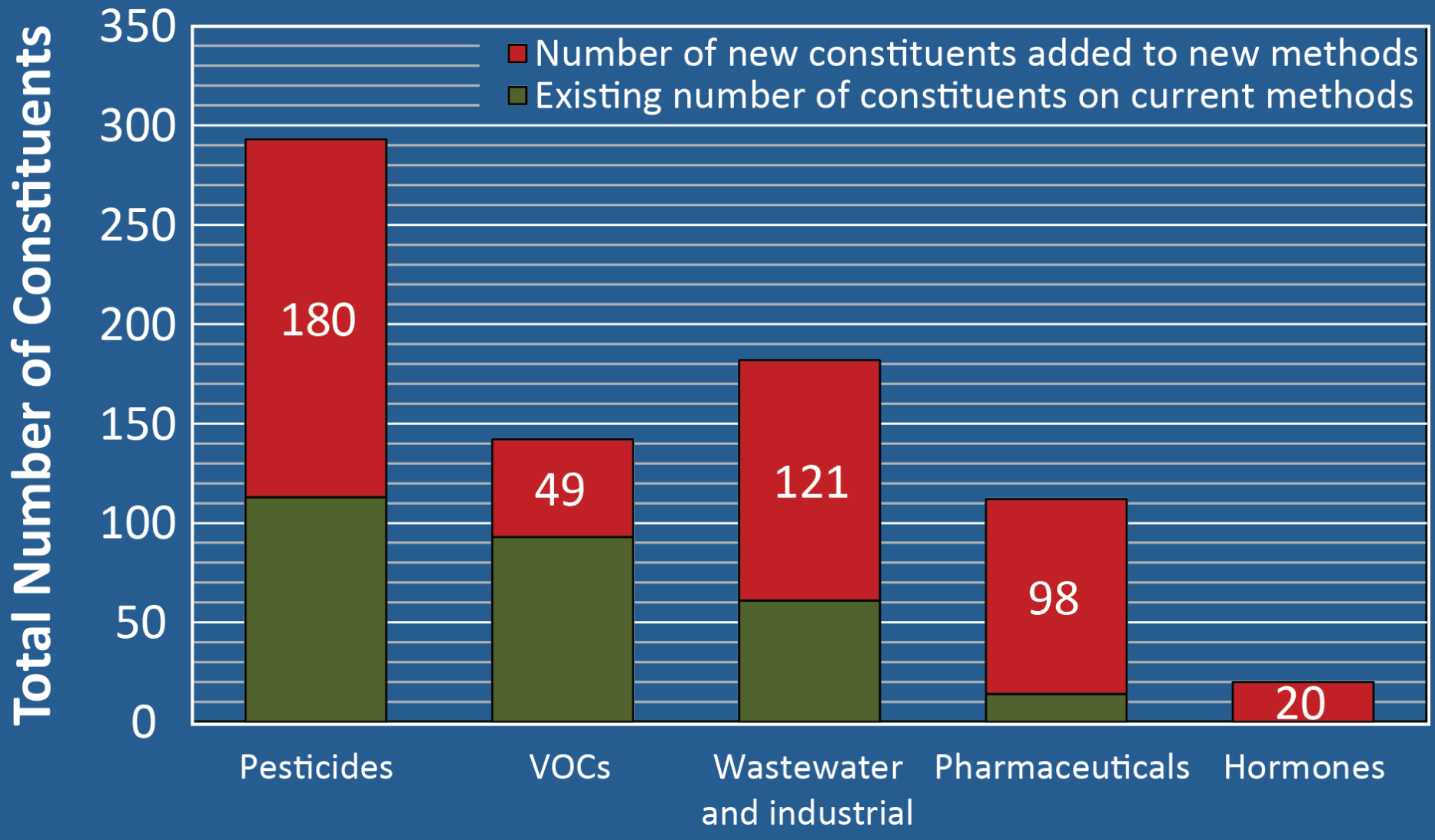
USGS

USGS Prioritization of Contaminants for Regional and National Monitoring of Water and Sediment

- National-scale monitoring of a wide variety of constituents in ambient waters.
- Low levels of detections for laboratory methods to achieve:
  - Contaminant occurrence
  - Long-term trends
  - Human and natural factors controlling spatial and temporal patterns

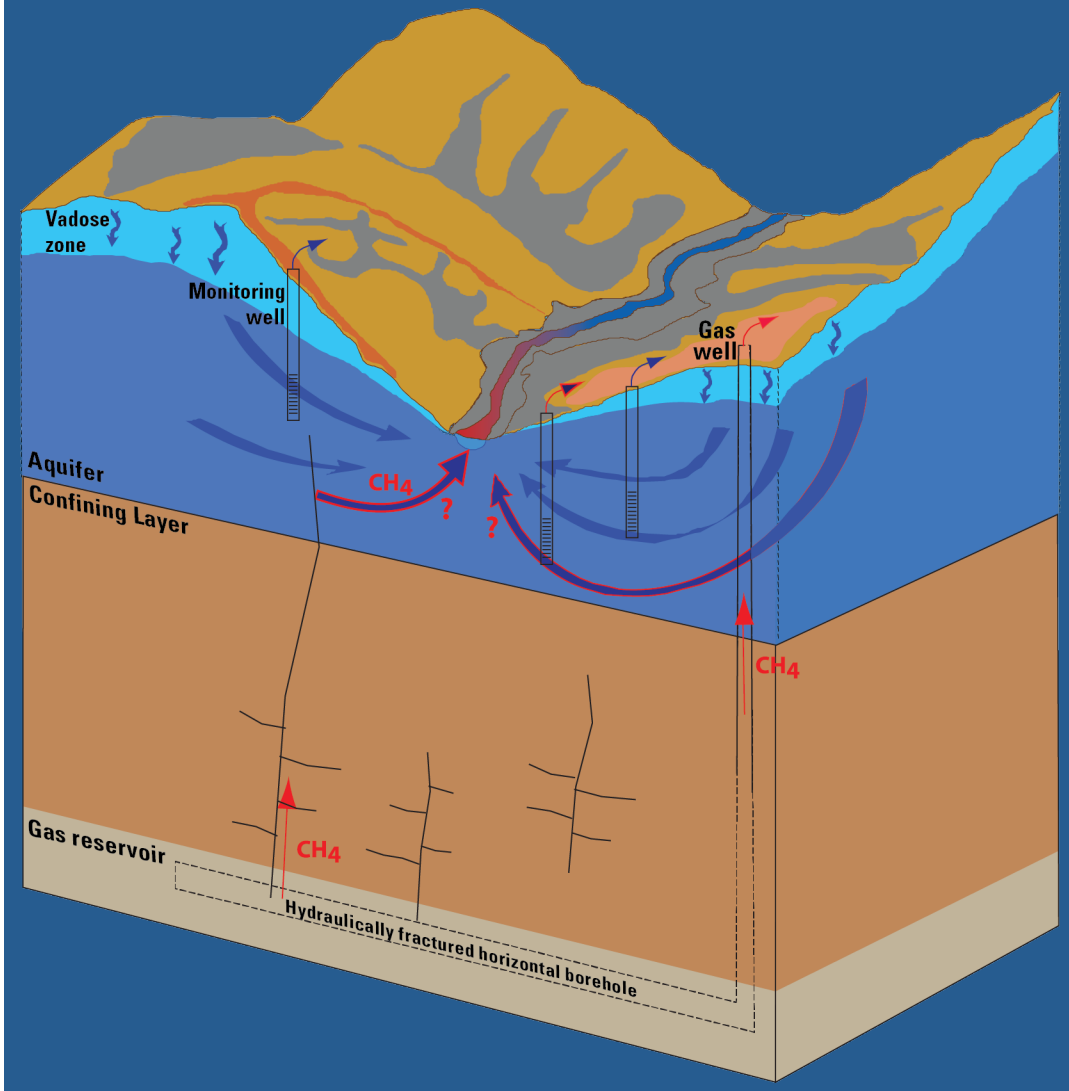
USGS

Priority for Water Sample Method Development



USGS

Stream methane monitoring:
New approach for evaluating impacts of unconventional gas development



Conceptual model of methane movement in the subsurface

- Gaining streams integrate watershed-scale groundwater quality
- Stream methane monitoring can identify thermogenic gas migration that may not be detected with monitoring wells
- The simplicity of collecting stream methane allows for regional-scale assessments of methane in groundwater
- Follow-up stream studies can determine methane source (e.g. migration of thermogenic shale gas) and concentration in groundwater
- Method successfully identified a stream in northern PA receiving methane-laden groundwater discharge from the Marcellus Shale

USGS

Enzymatic Reduction Discrete Analysis of Nitrite Plus Nitrate

- Eliminates toxic cadmium from reduction step
  - Less toxic waste costs, much greener method
- Incorporates clinical discrete analysis technology
  - Highly automated: cost reduction of ~50%
  - Improvement in data quality
  - Drastic reduction of reagent volumes – less waste

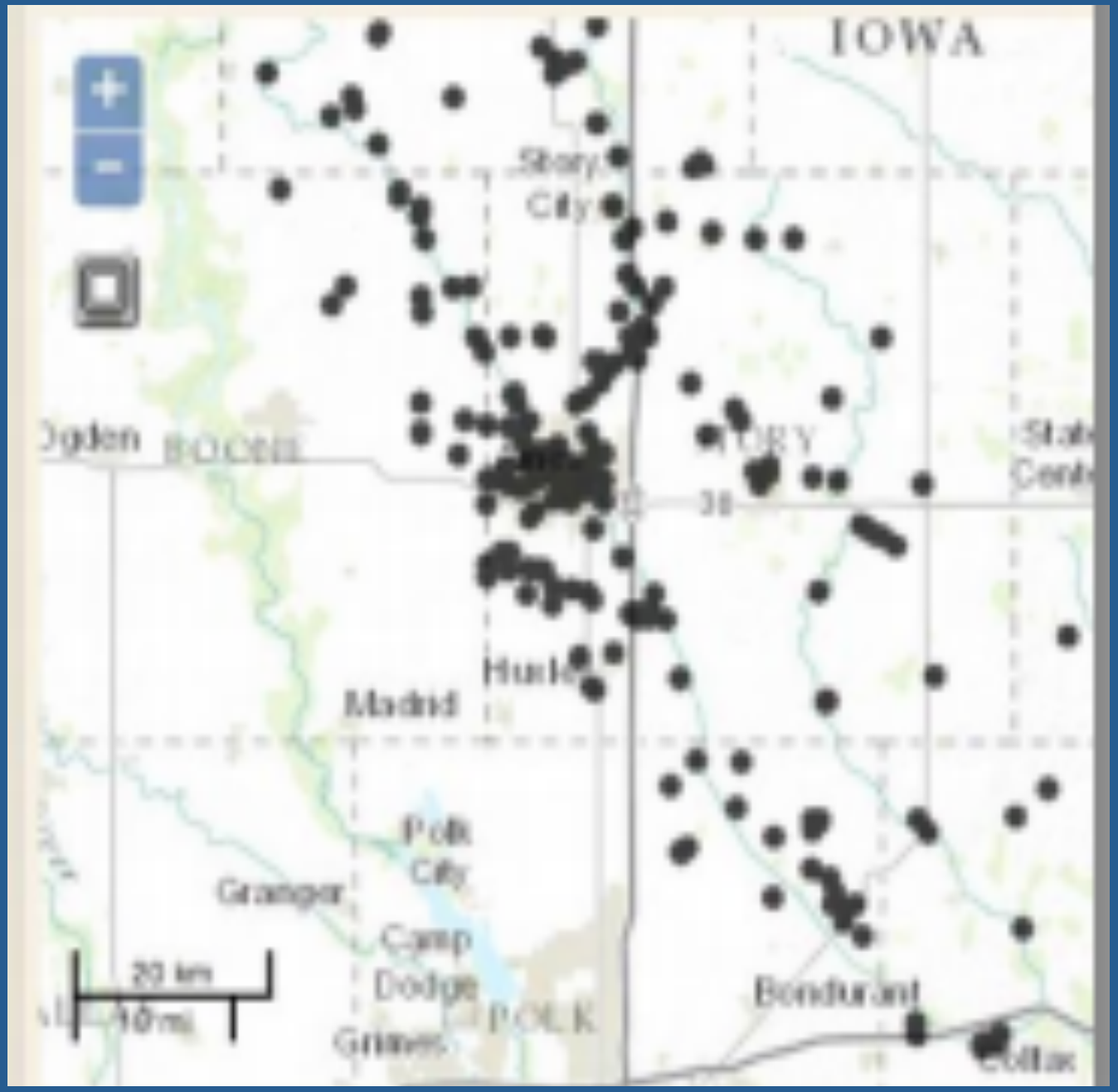
USGS

Analysis of Hormones in Water by GC/MS/MS with Isotope Dilution Quantification

- High degree of method coverage with exact analog labelled standards
  - Extremely high sensitivity and selectivity
  - Allows use of isotope dilution quantification
  - Can be used in extremely challenging matrices

USGS

Water Quality Portal – Expanding Data Holdings and Data Use



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USGS

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Contact:

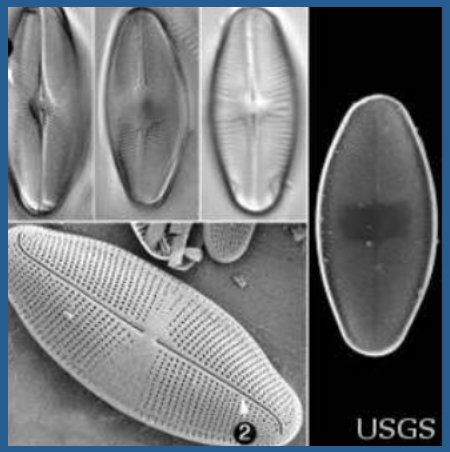
Bill Werkheiser

(703) 648-5817 (office)

whwerkhe@usgs.gov

http://water.usgs.gov

Online Guide to Diatoms of the U.S.



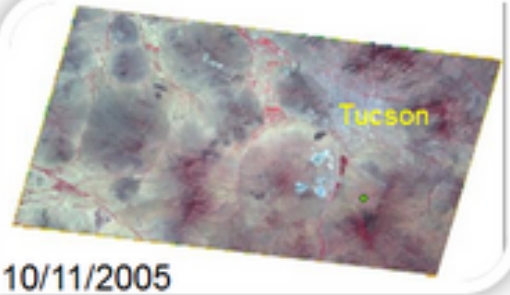
USGS

Conservation Easements and Sediment Source

Findings confirmed less movement of cropland sediment and streambank sediment in areas with Conservation Easements in agricultural parts of central Minnesota

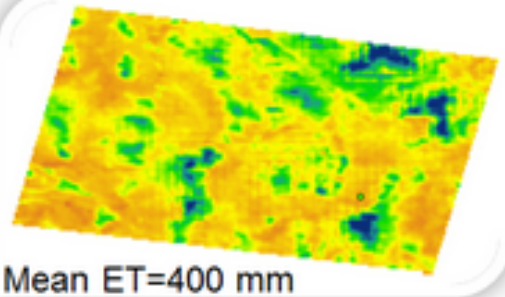
Comparison of Annual ET for 2005

Landsat false color composite (RGB 4,3,2)



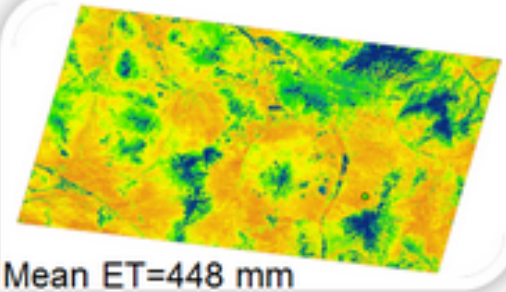
10/11/2005

MODIS based annual ET (SSEB)



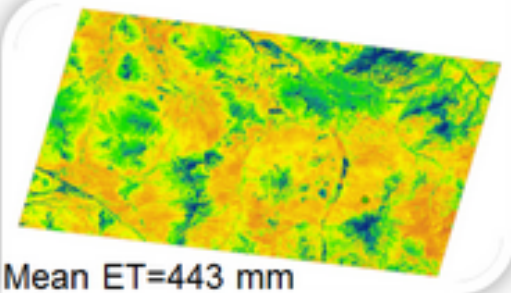
Mean ET=400 mm

Landsat based annual ET (SSEB_Daymet)



Mean ET=448 mm

Landsat based annual ET (METRIC)



Mean ET=443 mm

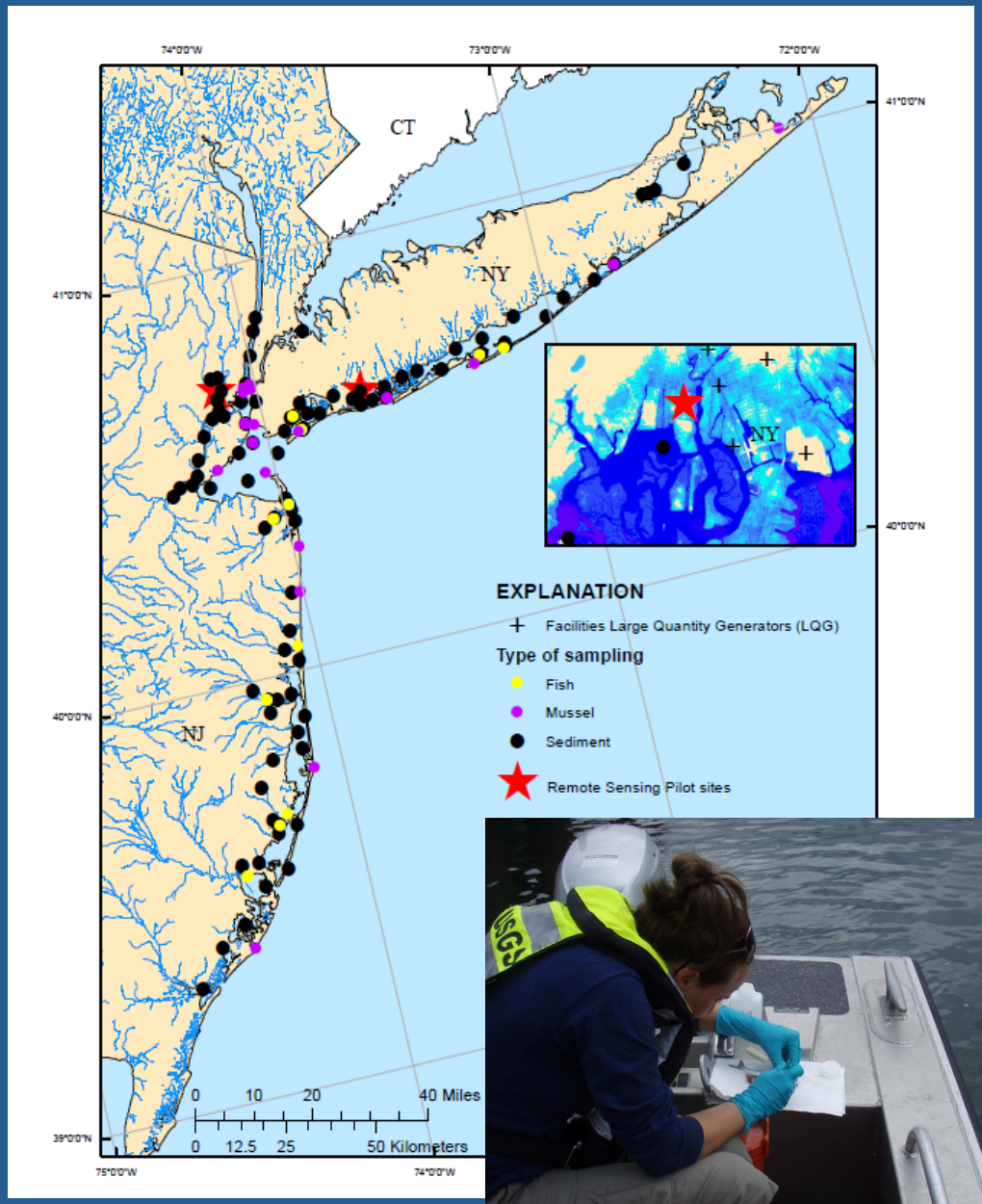
USGS

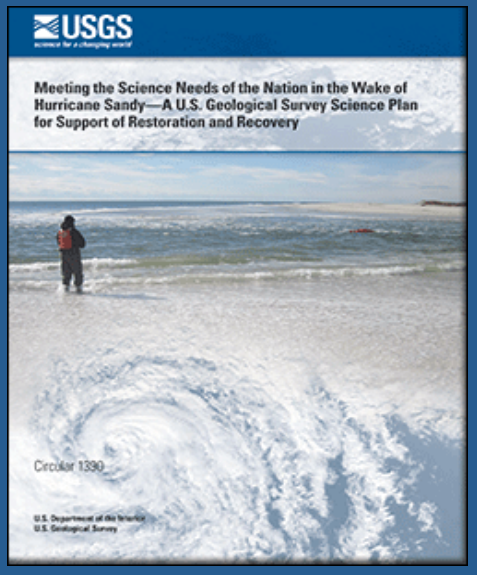
Colorado Basin States Technical WG Meeting

October 16, 2012 – Las Vegas, NV

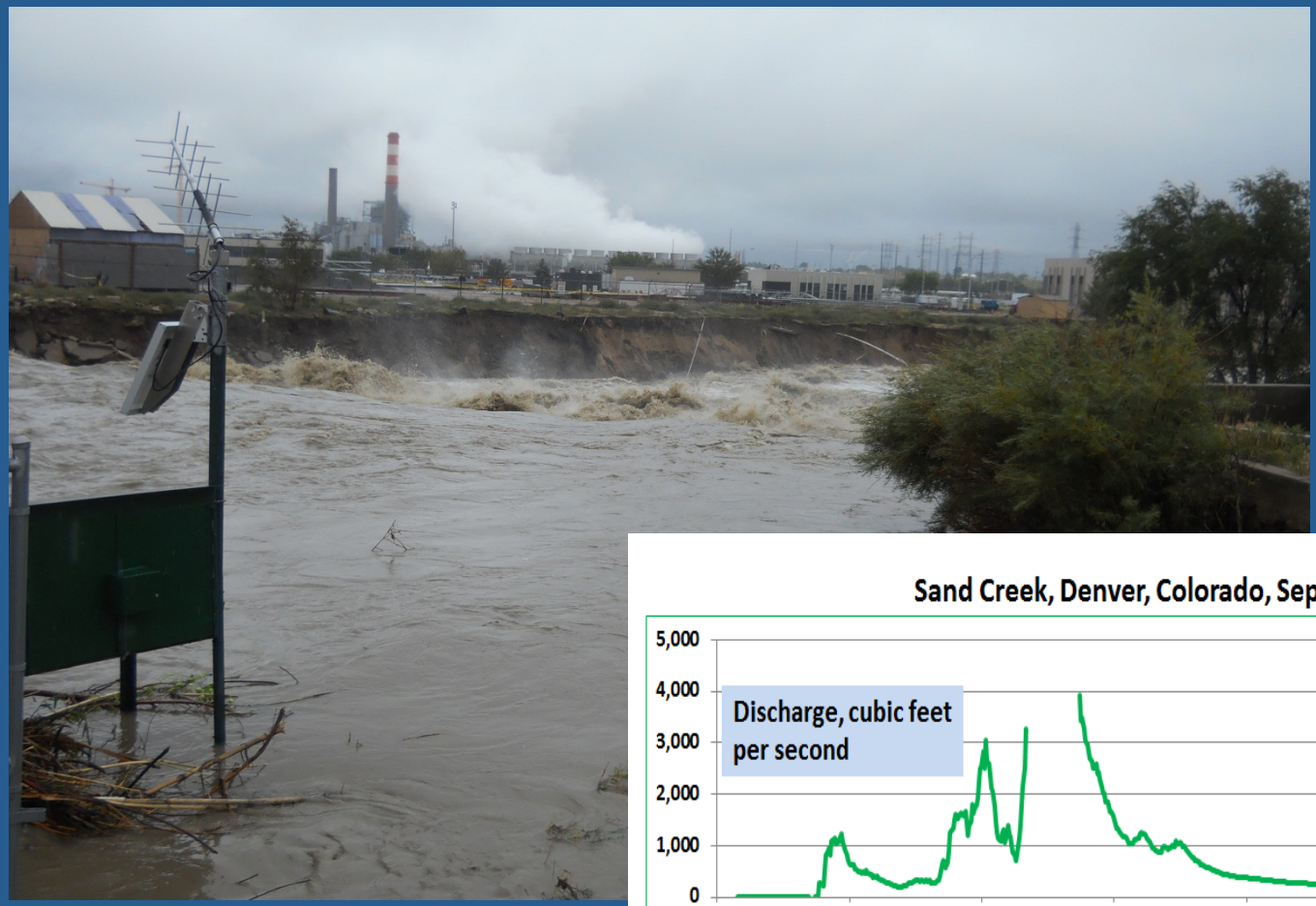
0 1000 mm

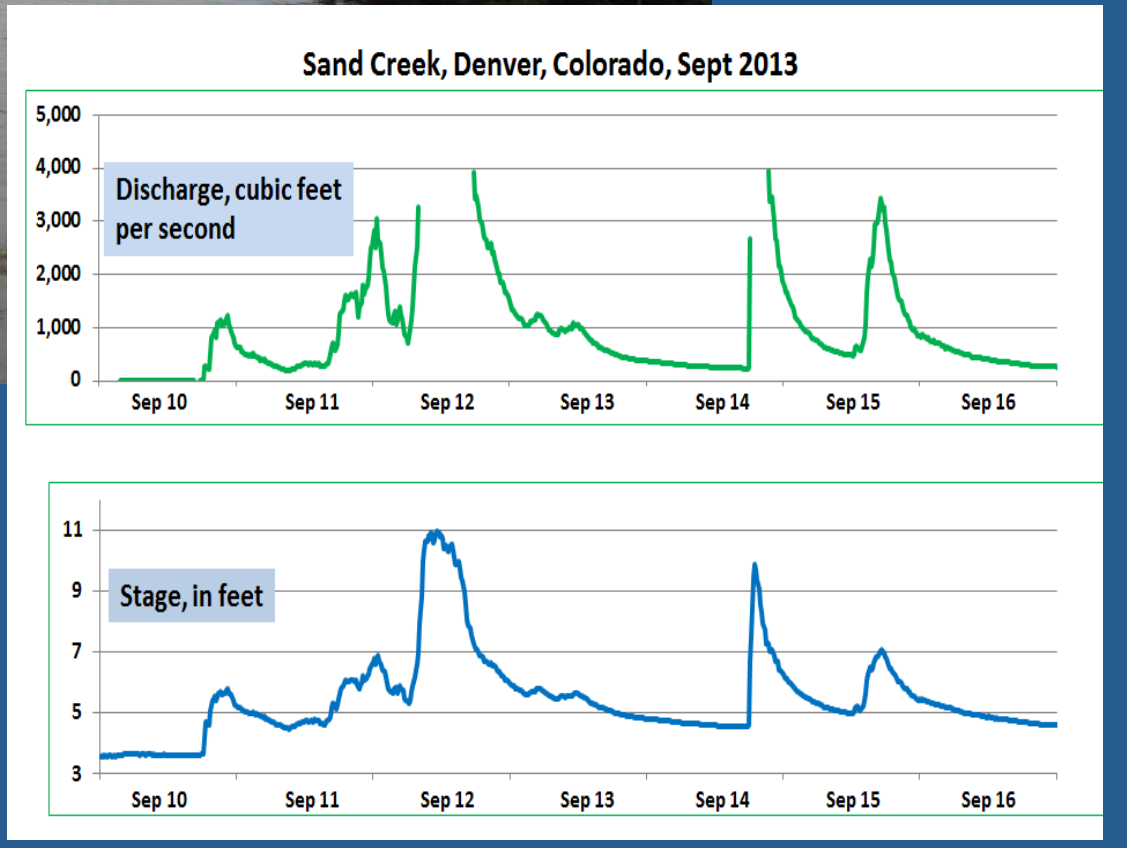
Toxic Contamination Hazard





USGS



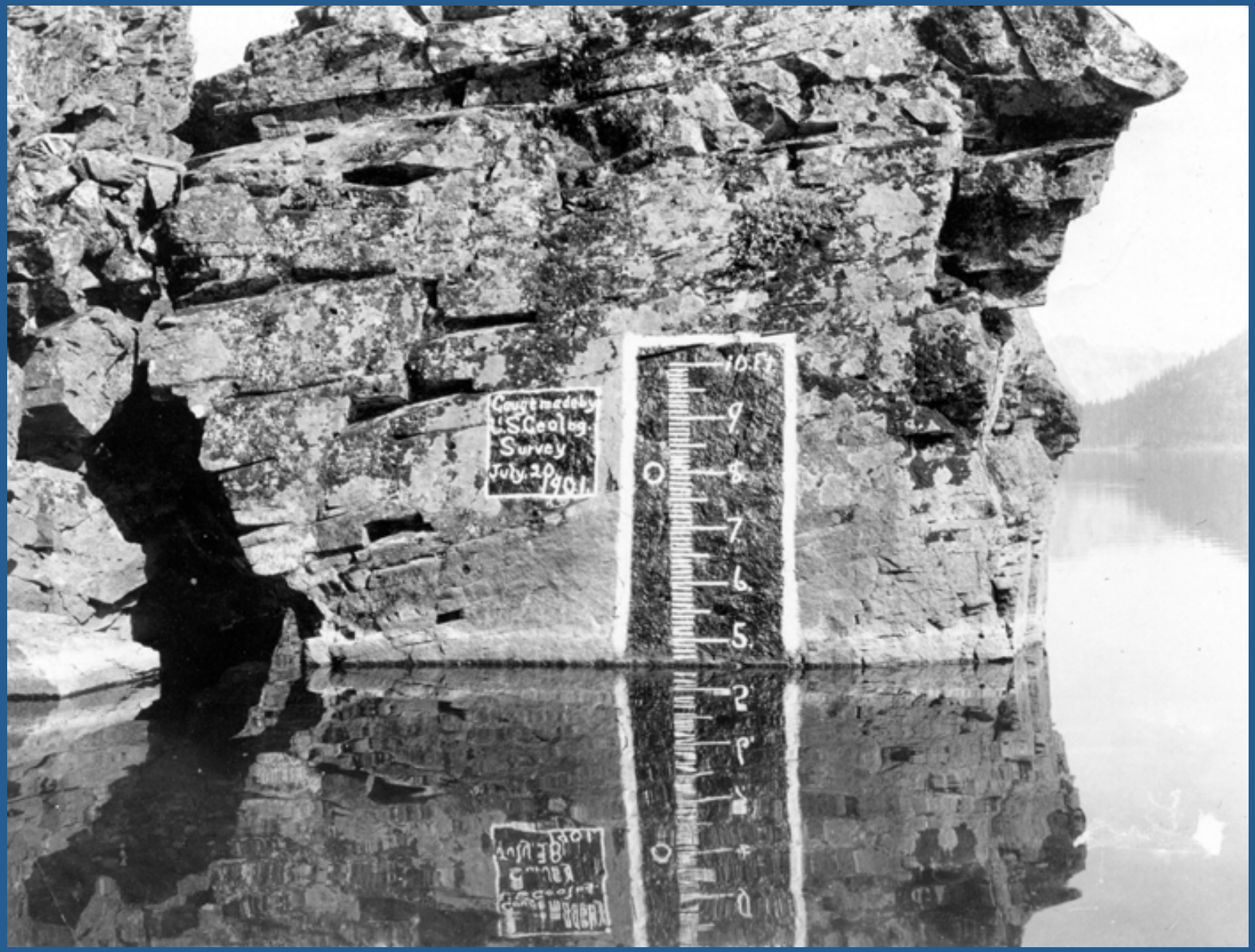


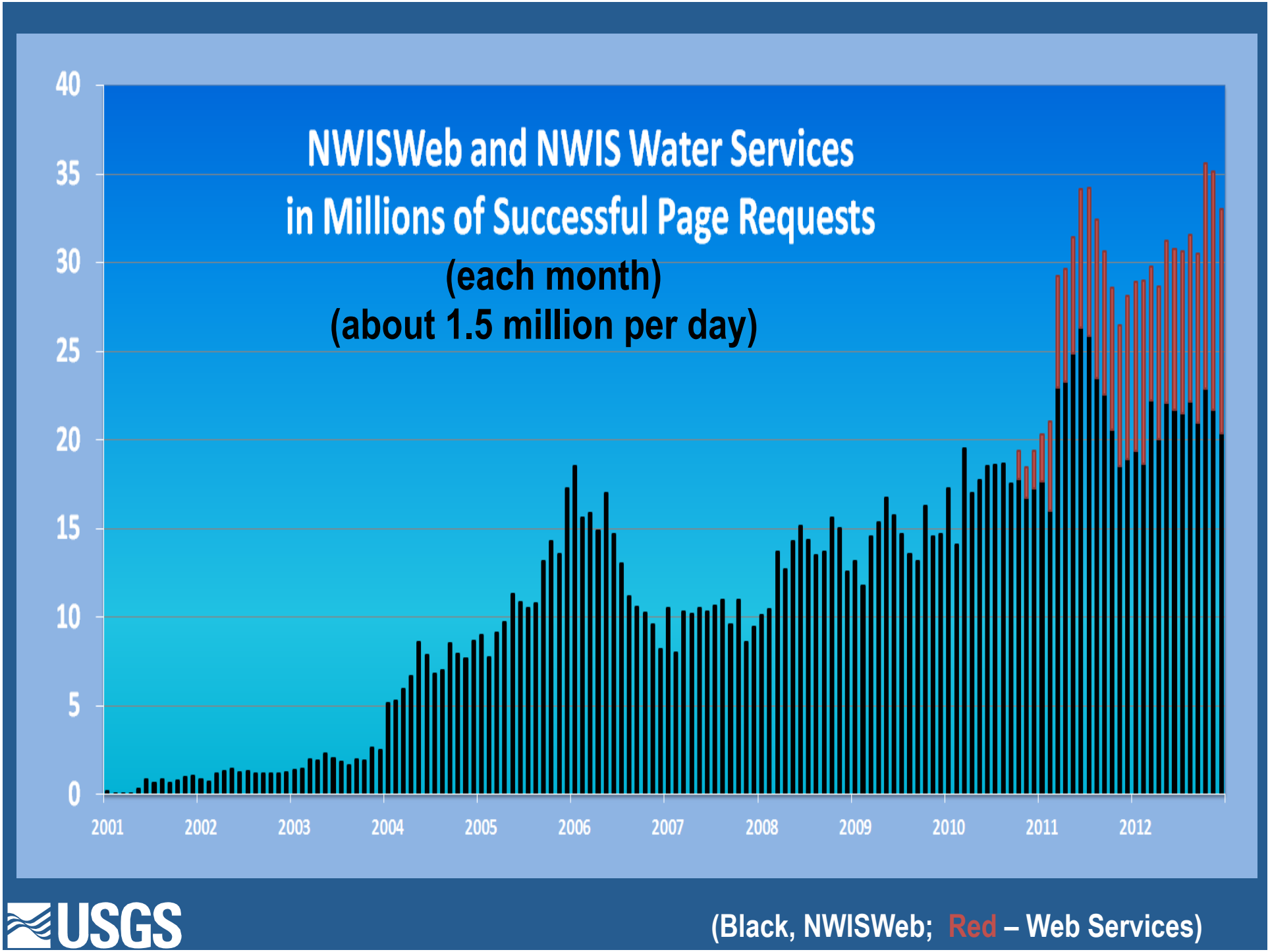
Record flooding in Sand Creek in the South Platte River Basin, September 2013

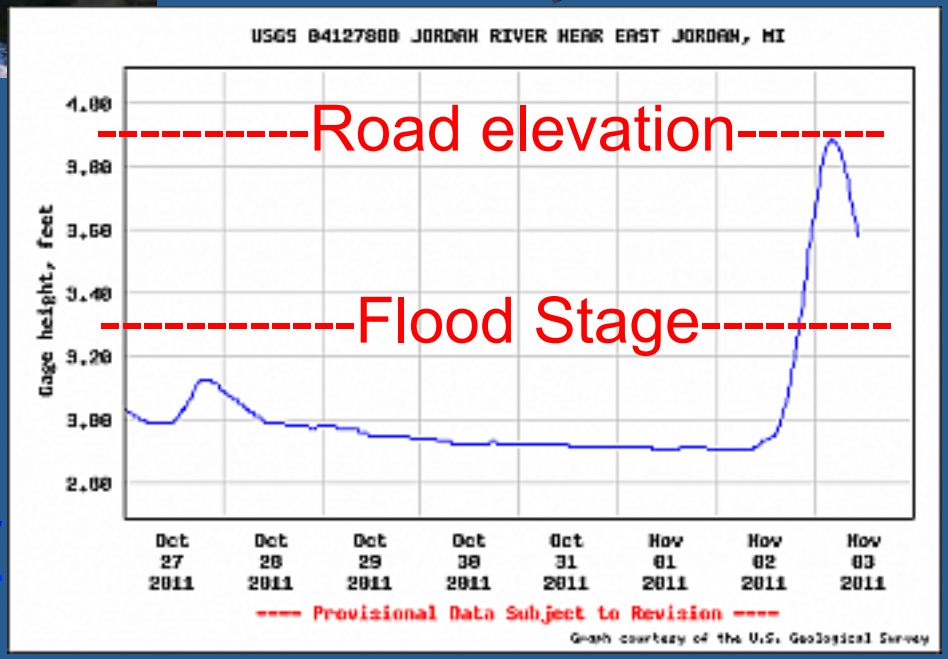
USGS

Record flooding in the South Platte River Basin, September 2013

Information Delivery




NWISWeb and NWIS Water Services
in Millions of Successful Page Requests
(each month)
(about 1.5 million per day)
40
35
30
25
20
15
10
5
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
USGS
(Black, NWISWeb; Red – Web Services)



USGS WaterAlert

Wireless or E-mail

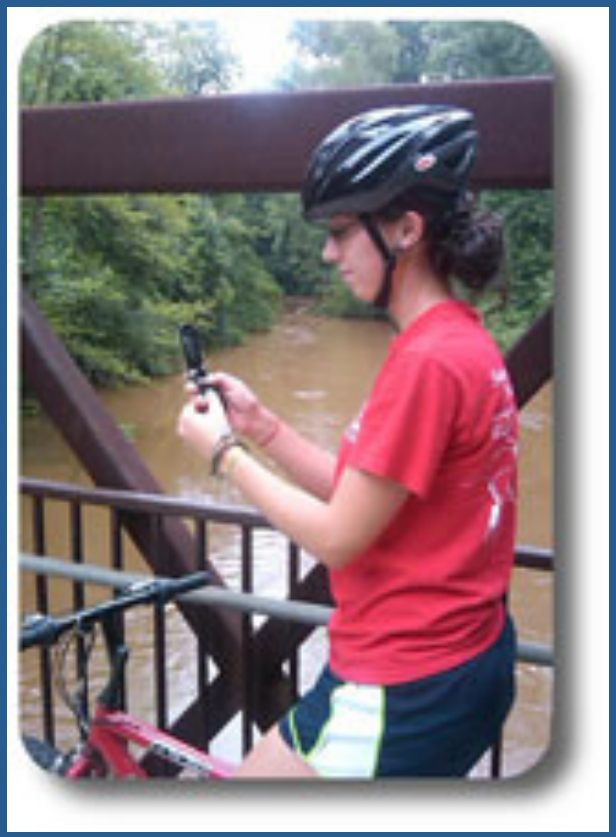
Customized WaterAlert

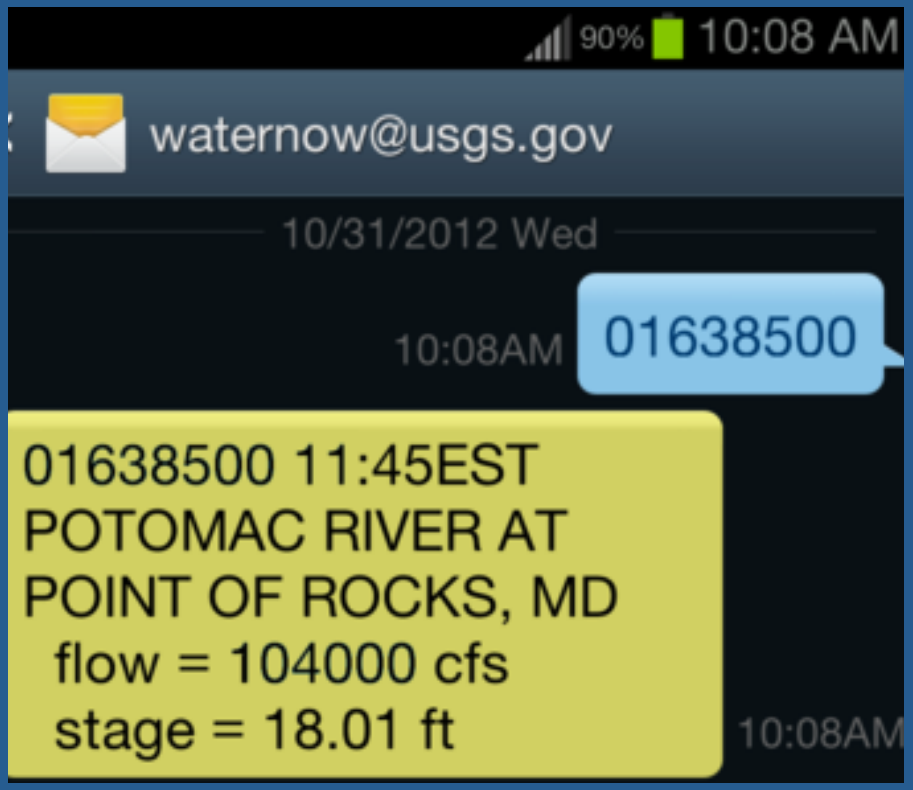
http://water.usgs.gov/WaterAlert/

USGS

USGS WaterNow

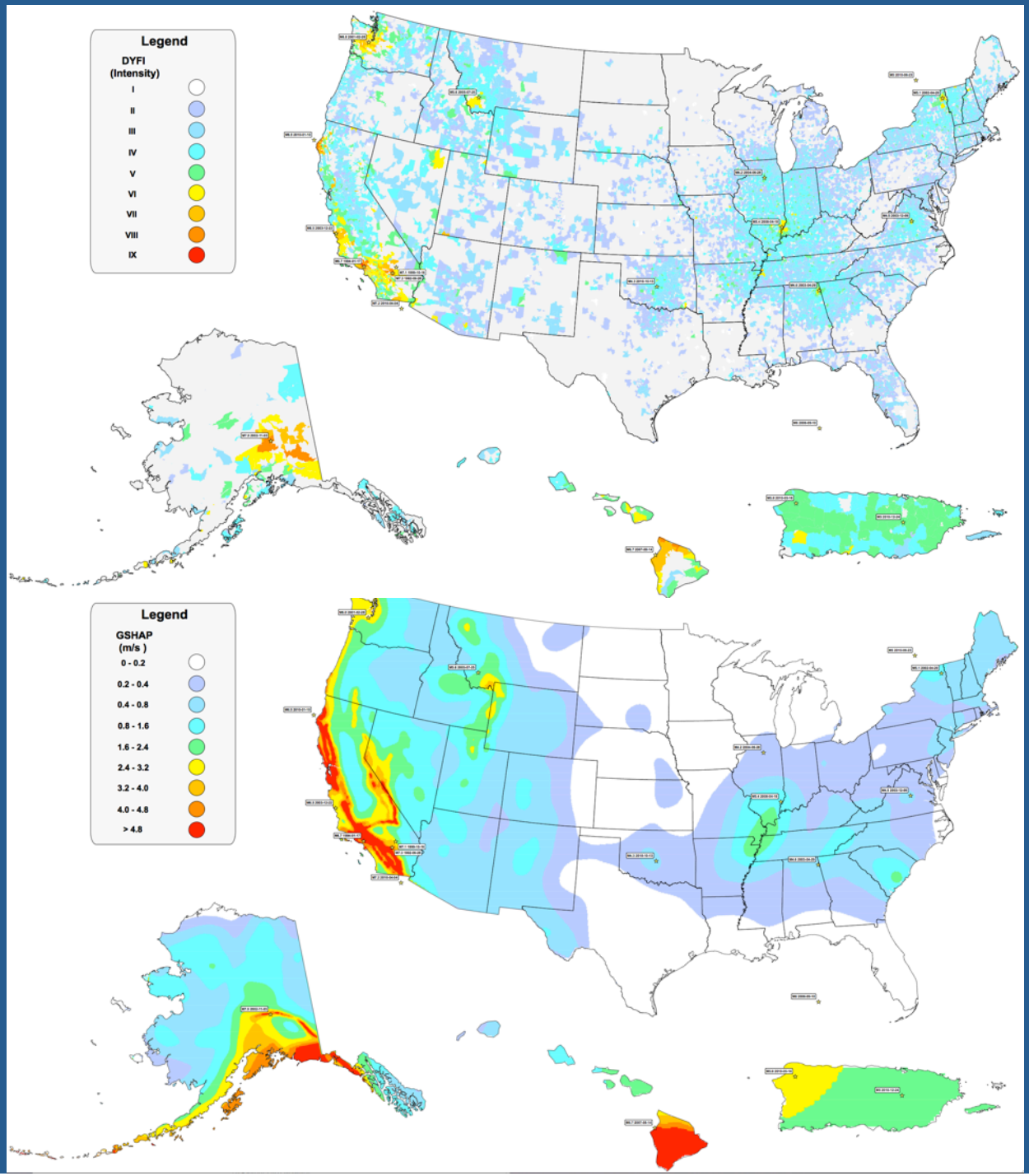
On-demand, current conditions for water data directly to your mobile phone or email





USGS

10 Years of DYFI Data (~2 *million* responses)



USGS National Seismic Hazard Map

(2% in 50 Year Probability of Exceedence)

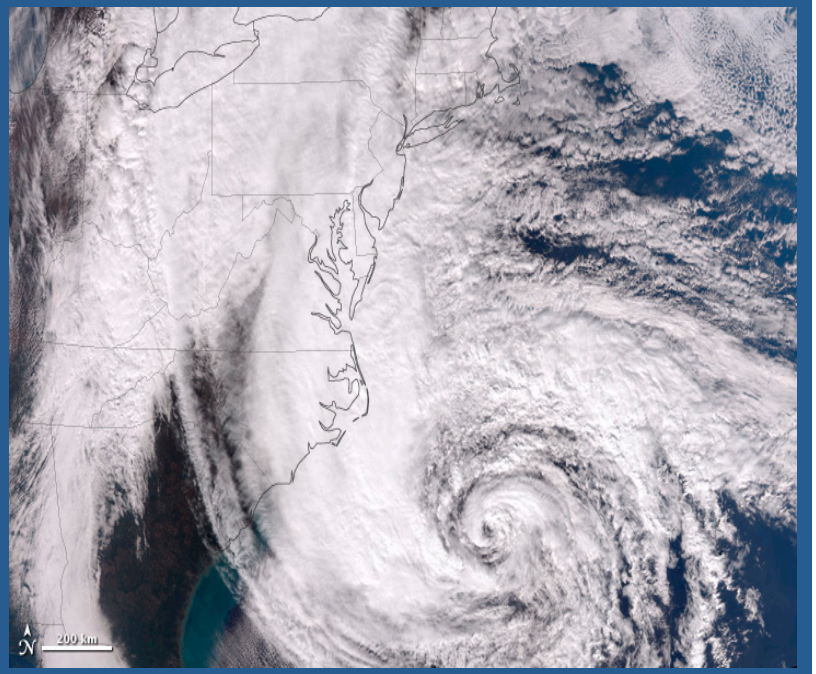
USGS

For questions:

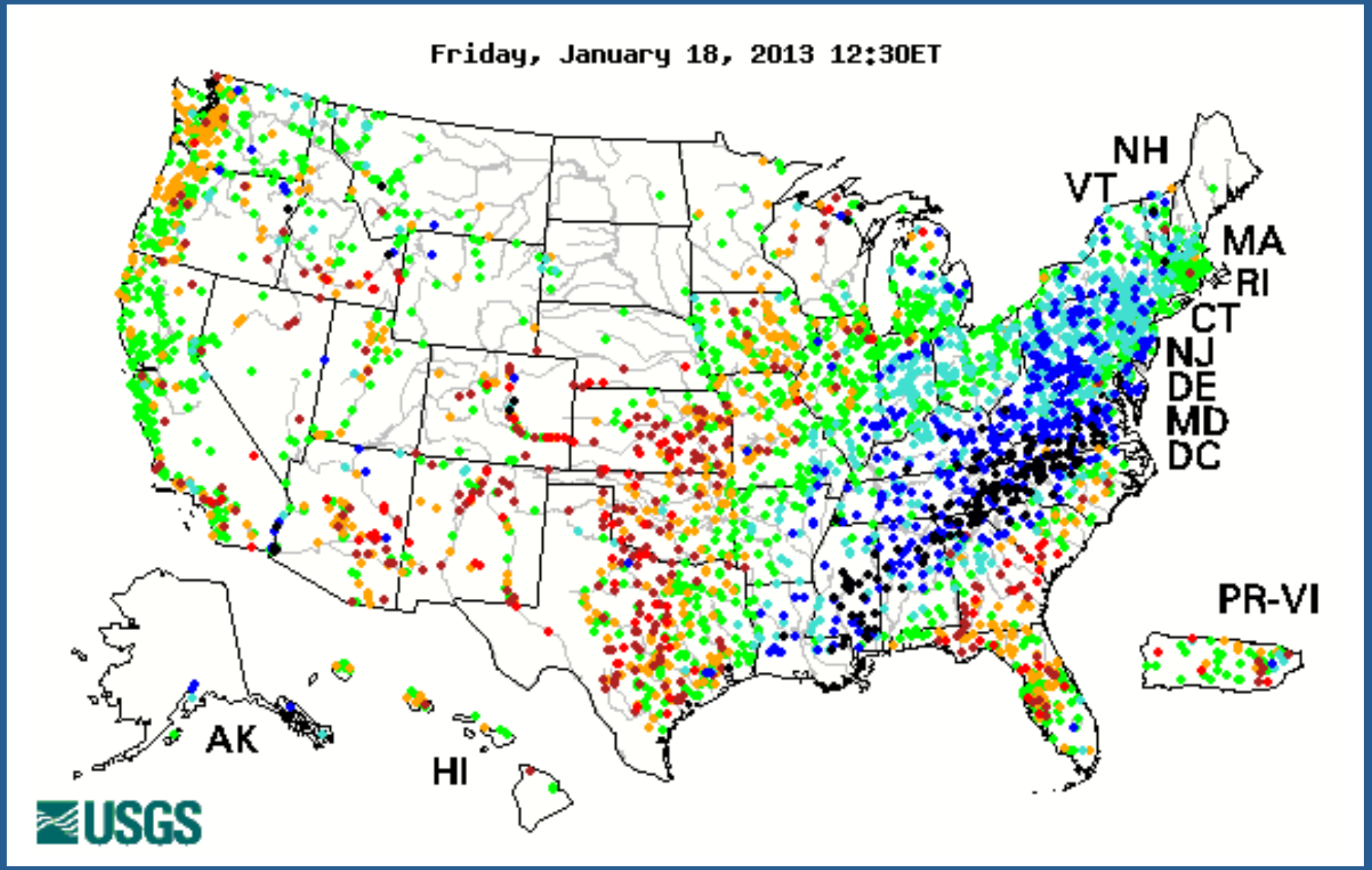
Contact:

Bill Werkheiser
USGS Deputy Director
October 28, 2013

USGS



The USGS Streamgaging Network – 8,000 gages (99 percent in real time)



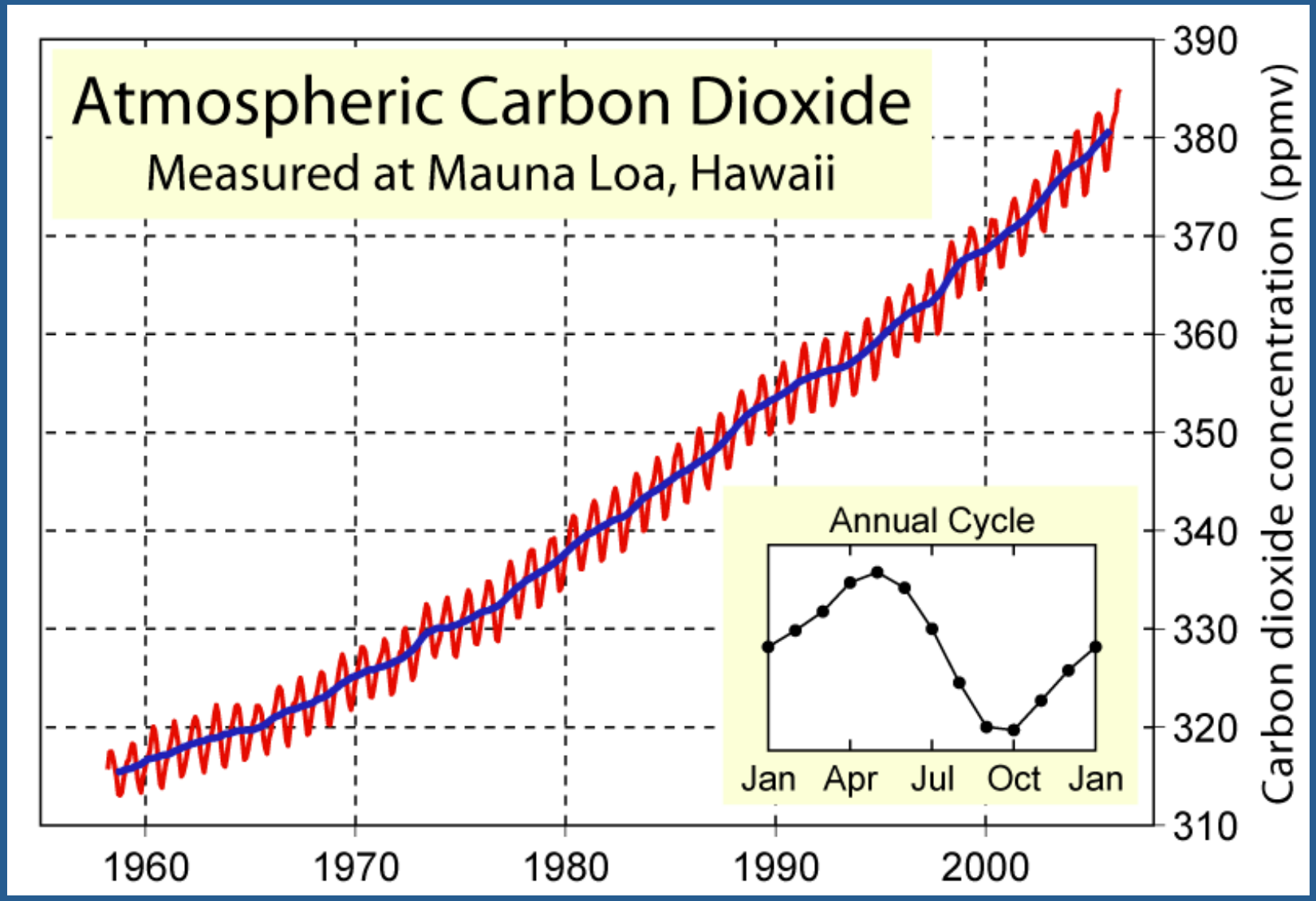
A continuing challenge to long-term Earth observations is the prejudice against science that is not directly aimed at hypothesis testing.

At a time when the planet is being propelled by human action …. We cannot afford such a rigid view of the scientific enterprise.

The only way to figure out what is happening to our planet is to measure it, and this means tracking changes decade after decade and poring over the records.

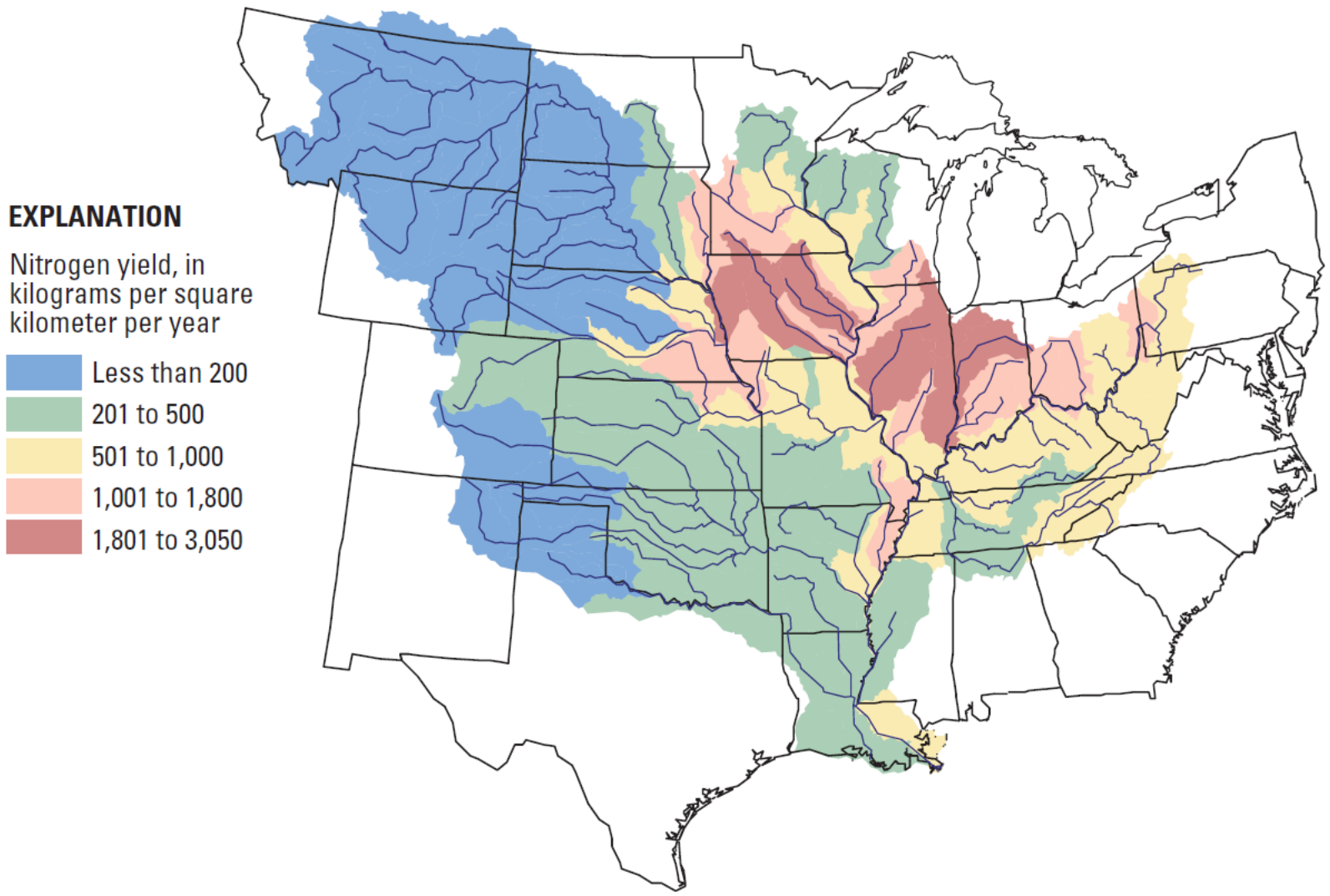
From Ralph Keeling

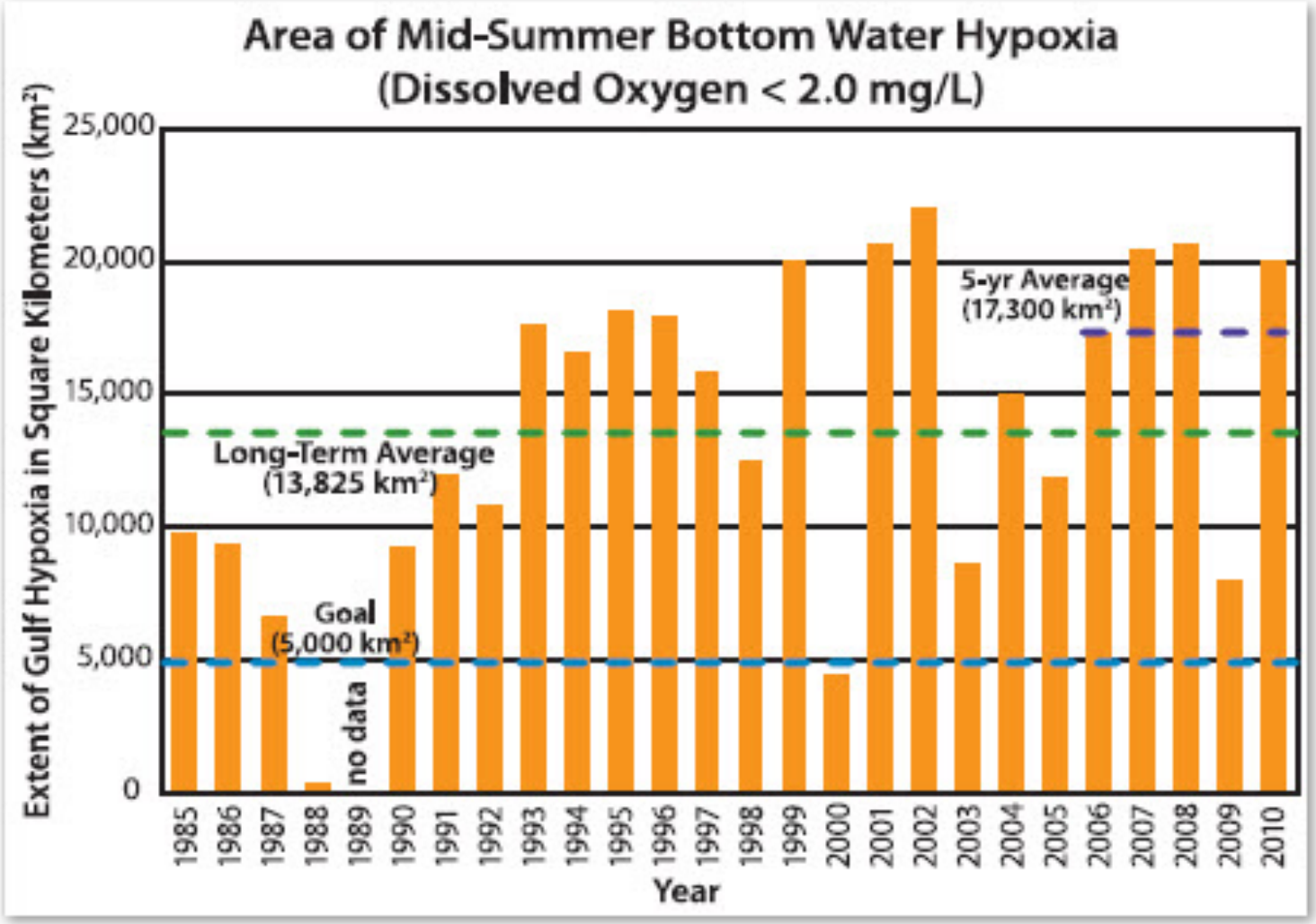
“Recording the Earth’s Vital Signs”



Science, 2008, p. 1771-1772, Ralph F. Keeling

Nitrogen Yields Within the Mississippi River Basin




Area of Mid-Summer Bottom Water Hypoxia
(Dissolved Oxygen < 2.0 mg/L)
Extent of Gulf Hypoxia in Square Kilometers (km²)
25,000
20,000
15,000
10,000
5,000
0
Long-Term Average
(13,825 km²)
5-yr Average
(17,300 km²)
Goal
(5,000 km²)
no data
1985
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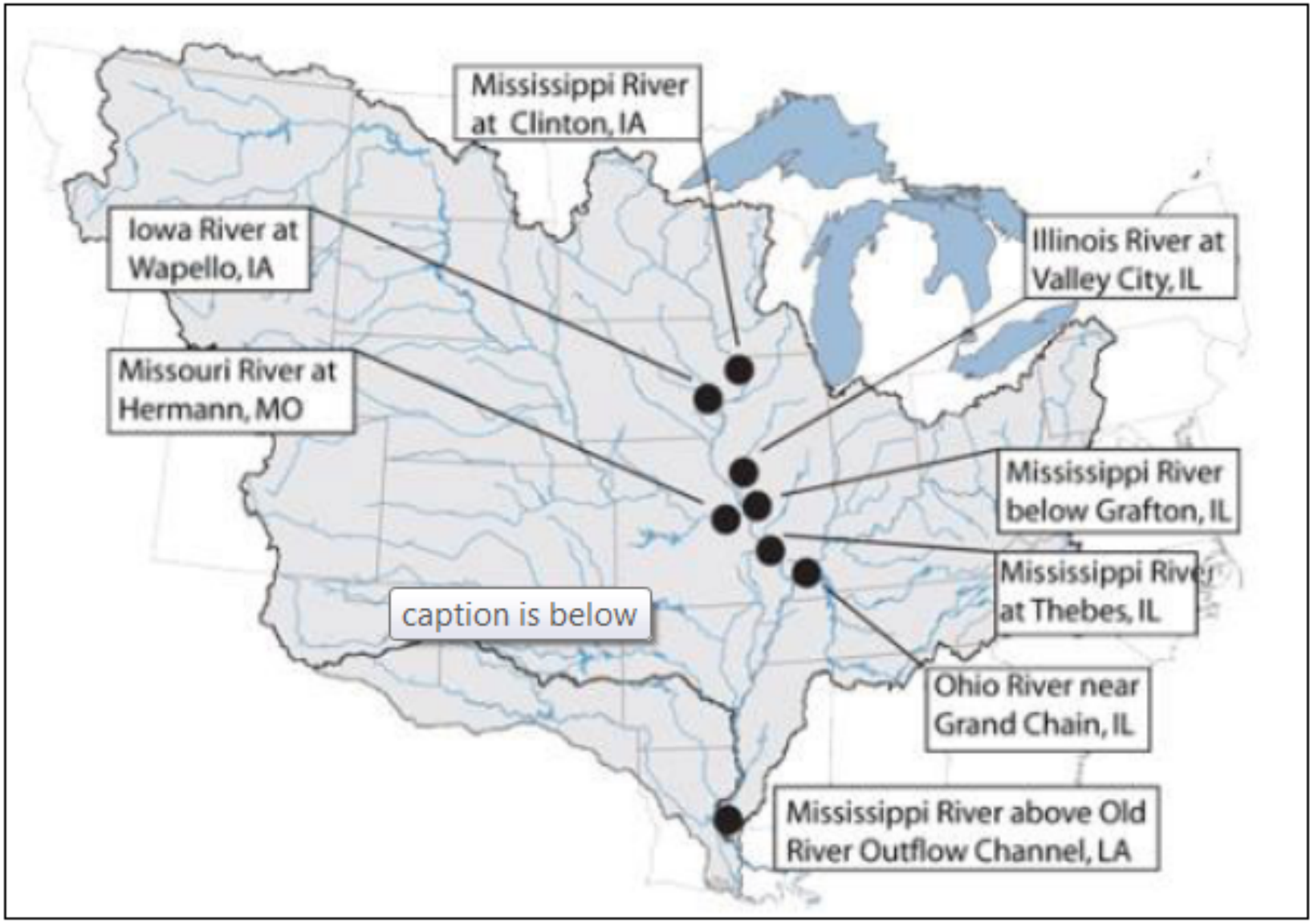
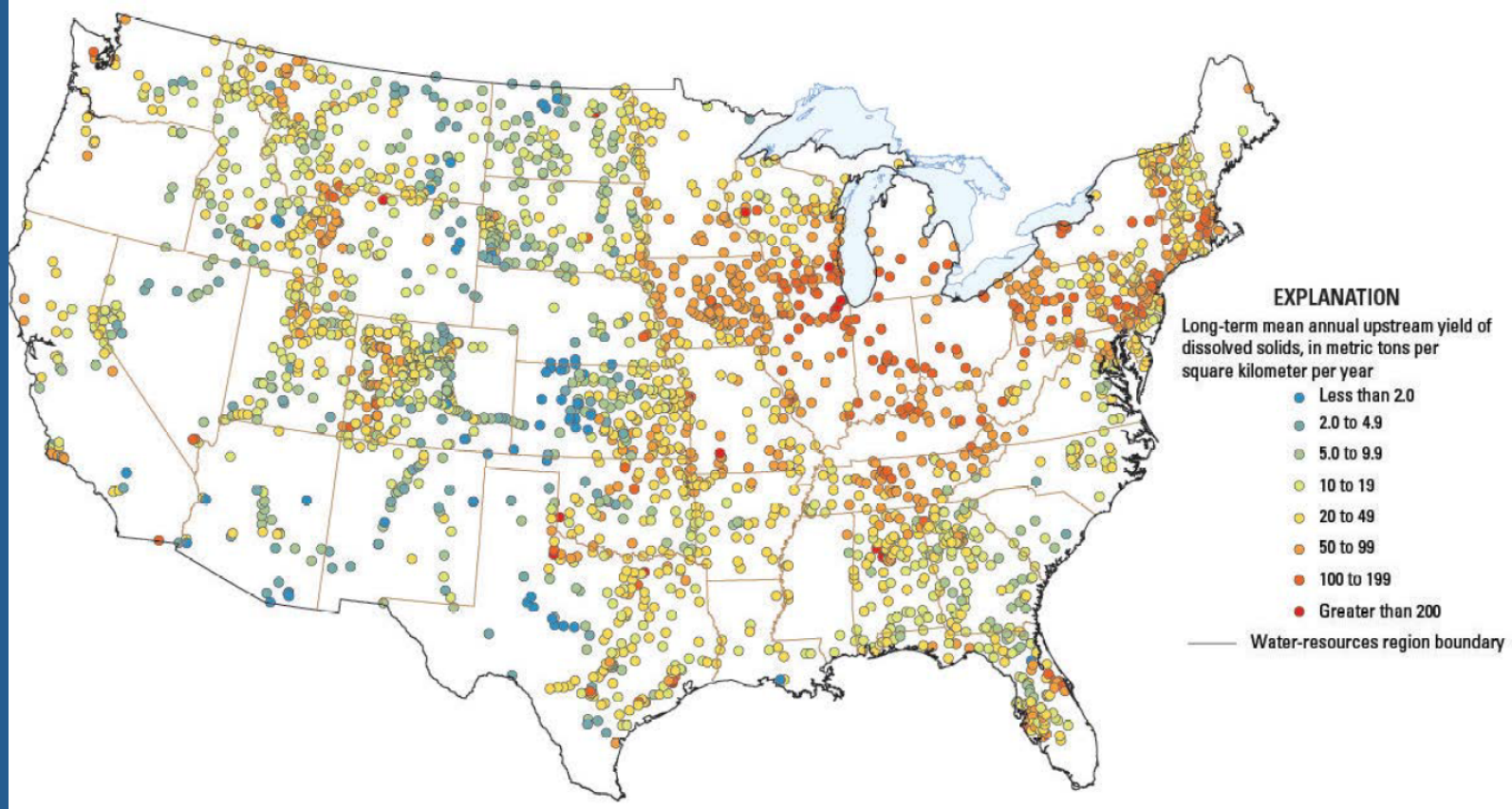
2010
Year

Nitrate trends evaluated from 1980 to 2010 at 8 long-term USGS monitoring sites in the Mississippi River Basin



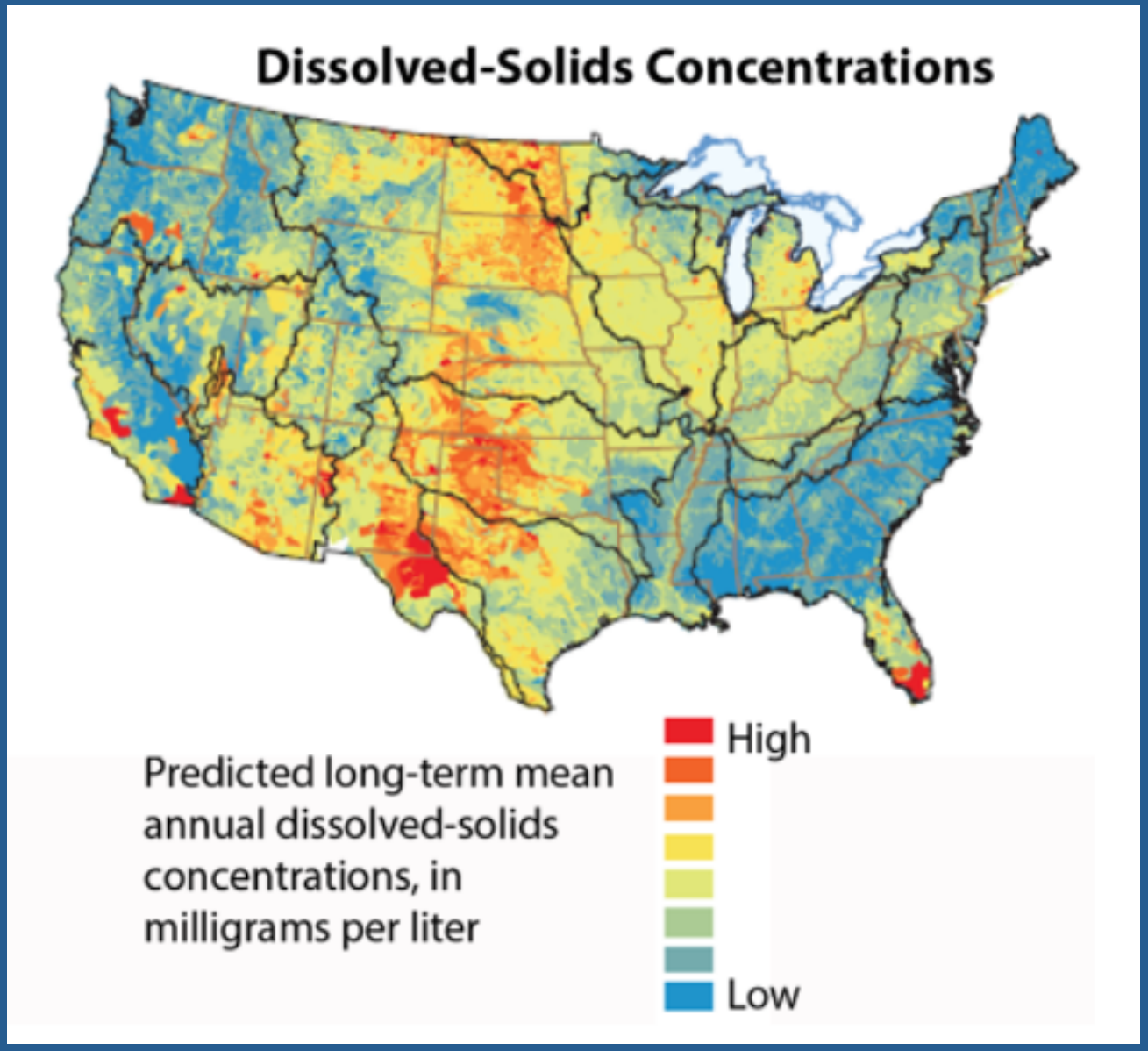
Monitoring Data Are Critical for Modeling



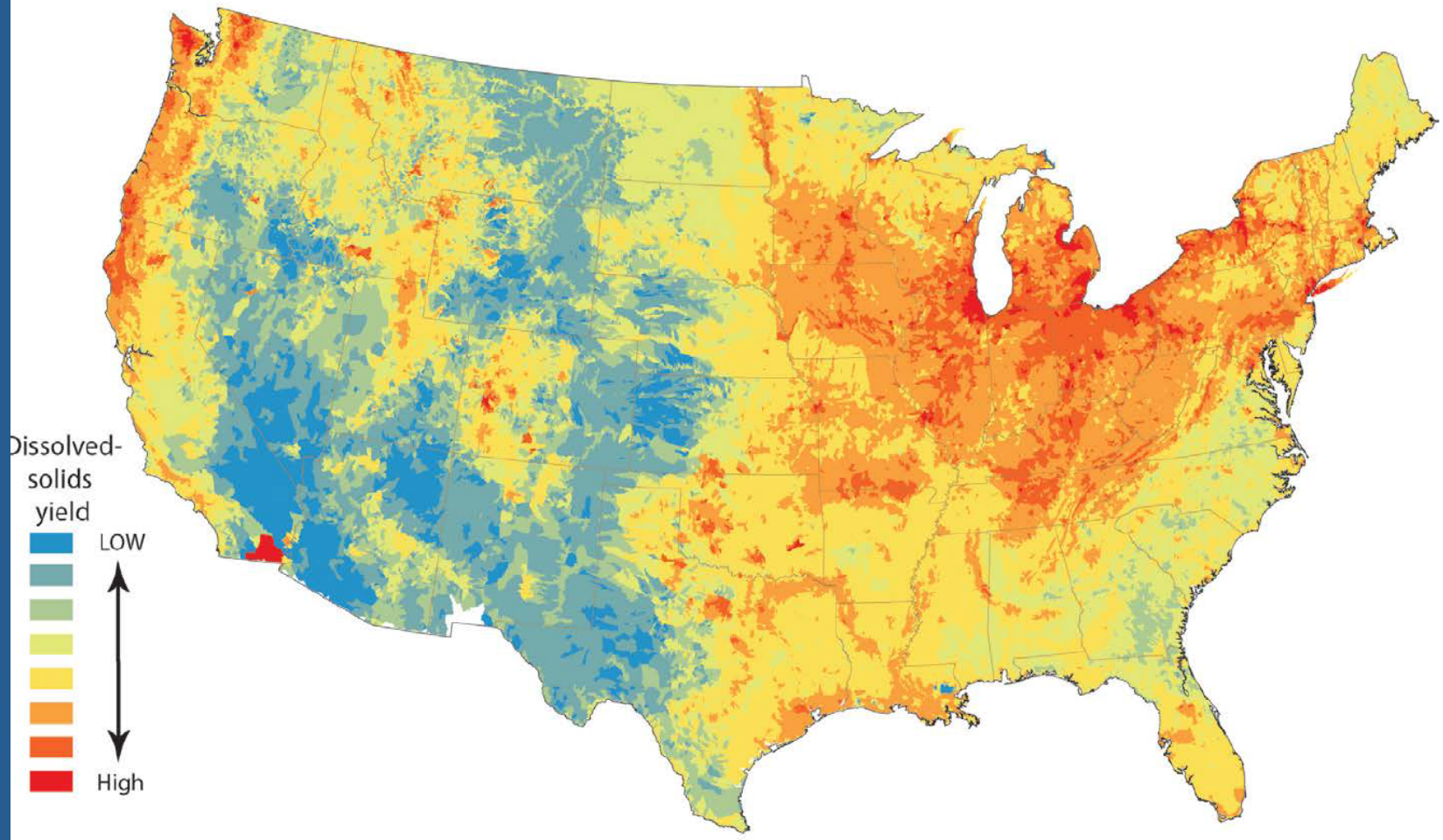
2,560 calibration sites from USGS NWIS and EPA STORET databases

USGS

Sources, Loads, and Concentrations of Dissolved-Solids in Streams



Dissolved-Solids Yields



USGS

Depth-dependent water-quality sample collection

Production pump

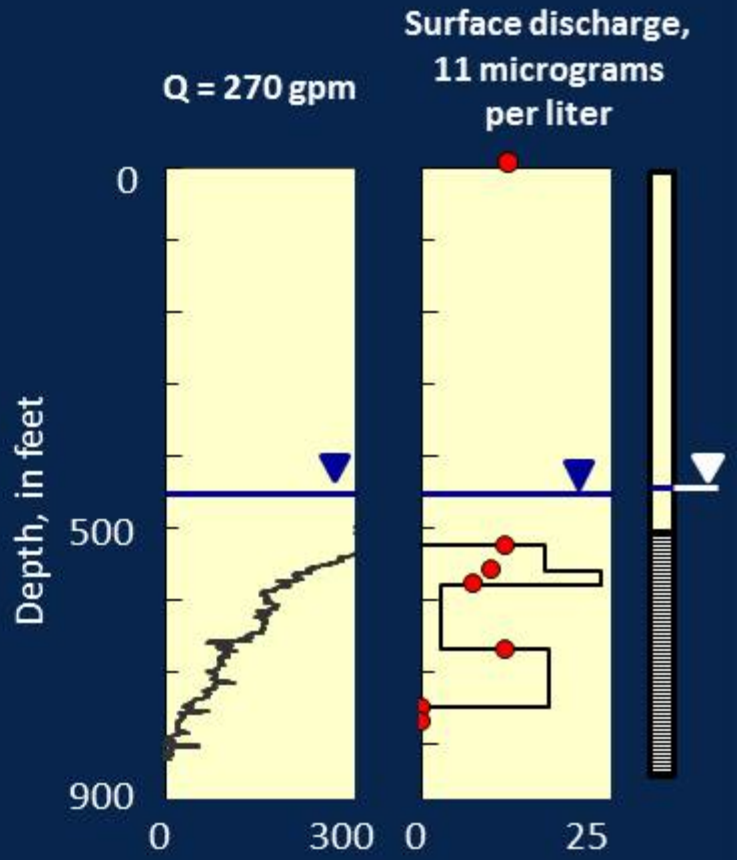
2-in diameter PVC pipes for large volume samples

Depth-dependent sample points for smaller volume samples (Barcad pump)

Samples are a mixture of water from the next deepest sample depth and water that entered the well between the two sample depths

CV = CV + CV

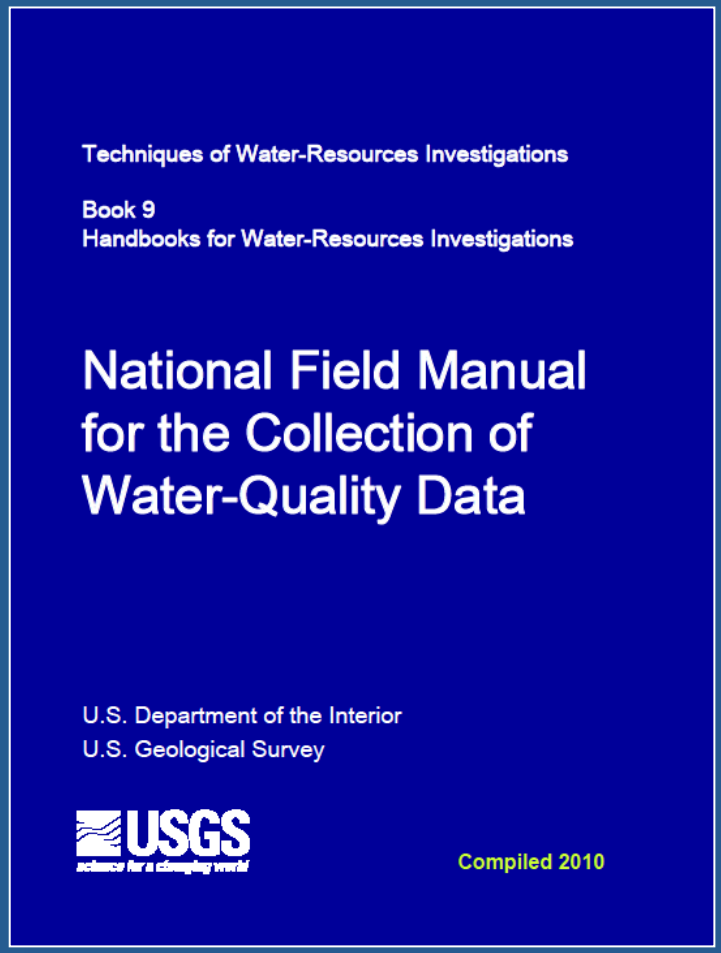
Deepest sample represents quality of water in aquifer at sample depth



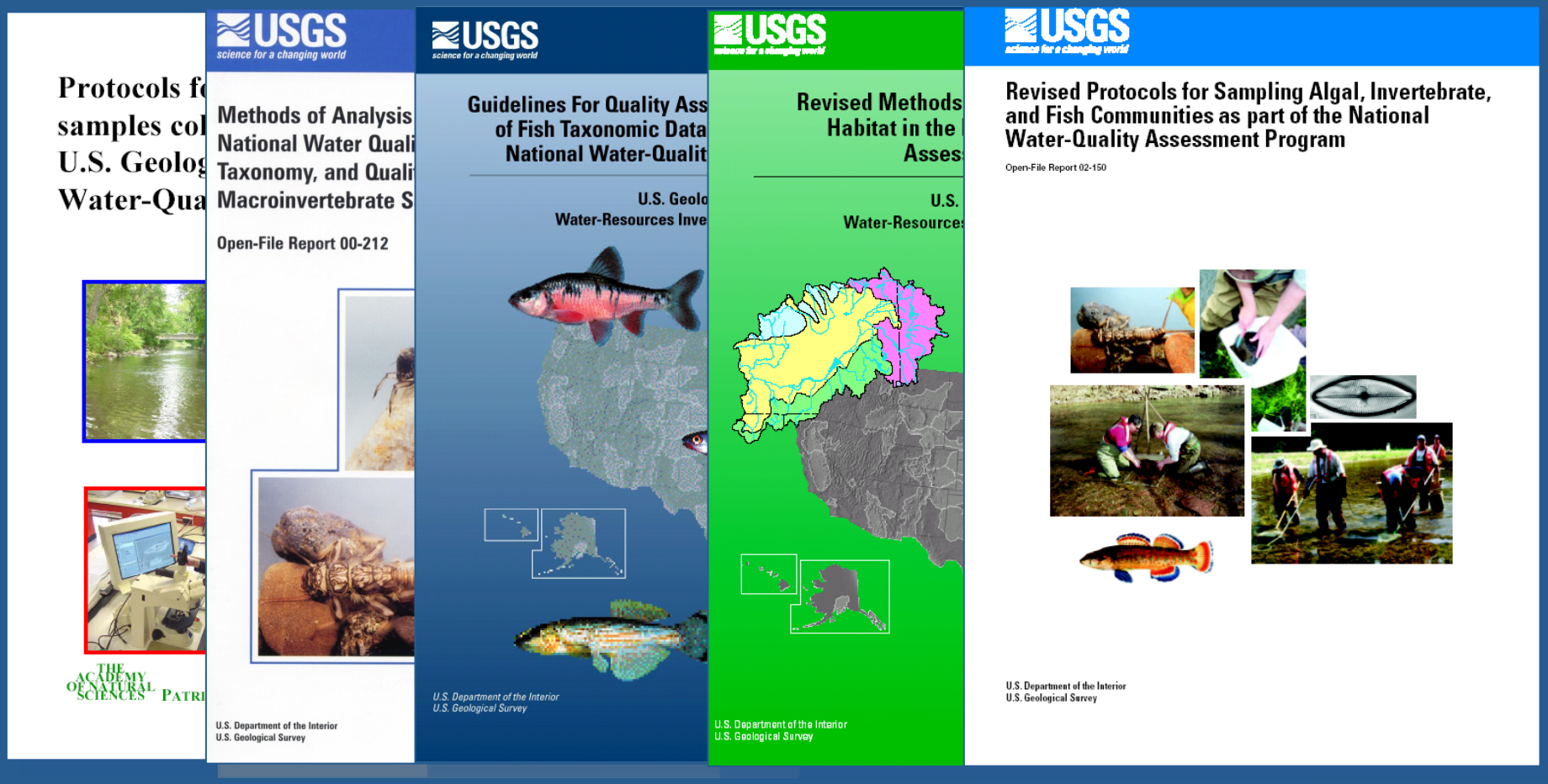
USGS science for a changing world

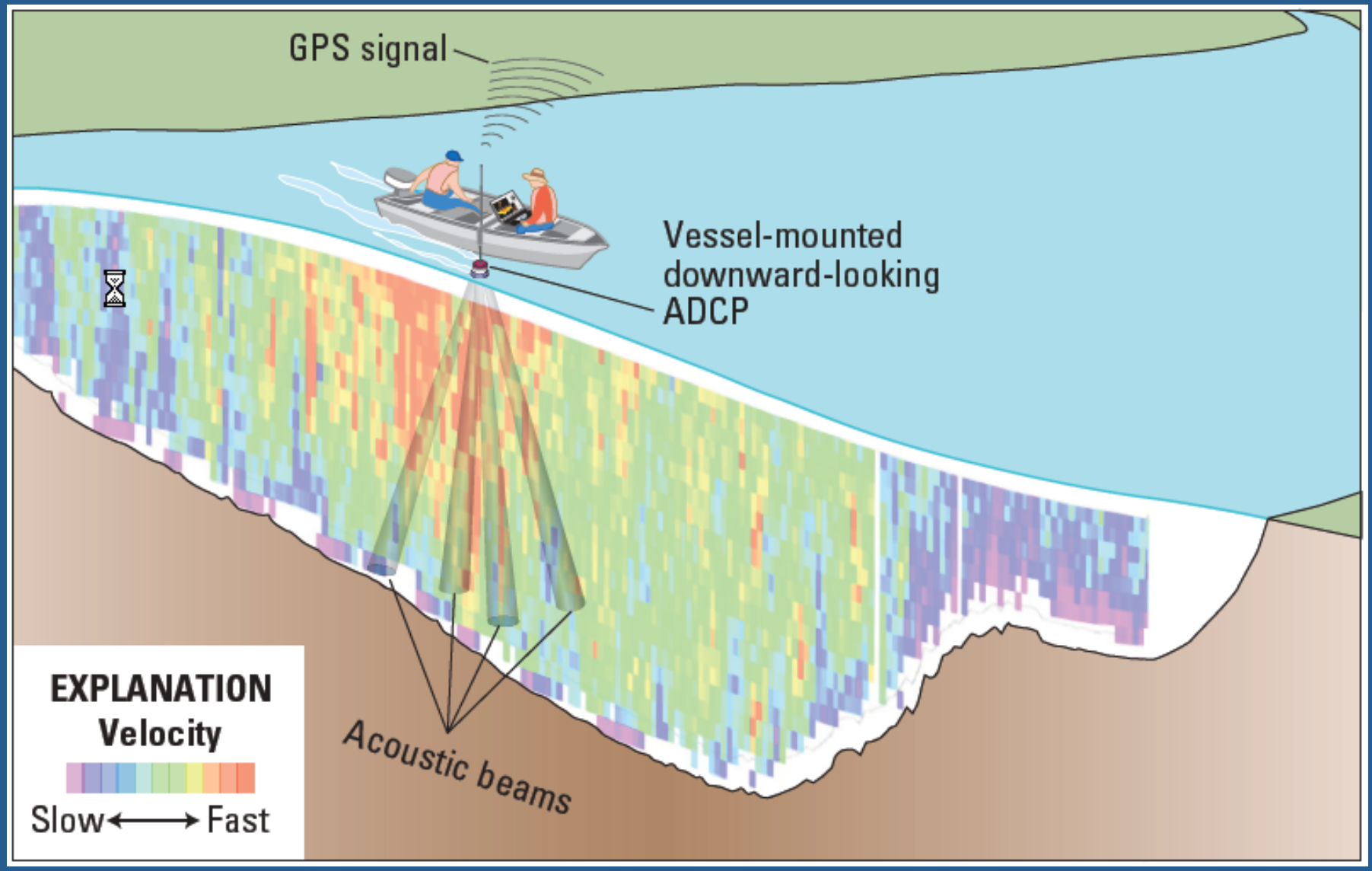
Supporting Infrastructure: Standardized Protocols for Collection of Water-Quality Data

- Achieve consistency in the scientific methods and procedures used
- Document methods and procedures
- Facilitate sharing of data and resources
- National Environmental Methods Index (www.nemi.gov)



Supporting Infrastructure: Standardized Protocols for Assessing the Condition of Aquatic Communities





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Water Resources Mission Area