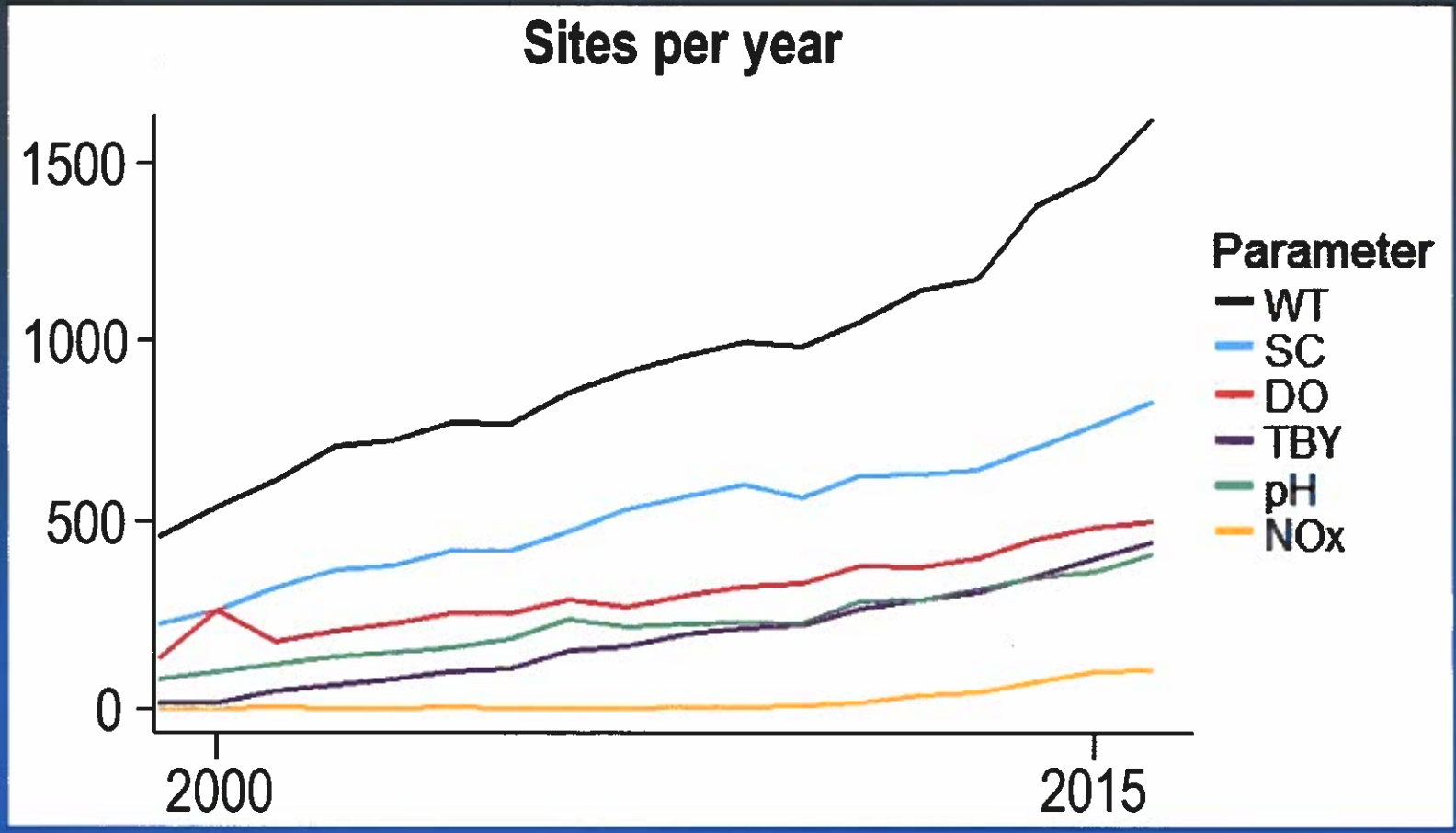
US Geological Survey Techniques for Continuous Water-Quality Data Collection, Processing and Dissemination

Patrick Rasmussen

St John's, NF, November, 2018

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

Growth of USGS water-quality sites



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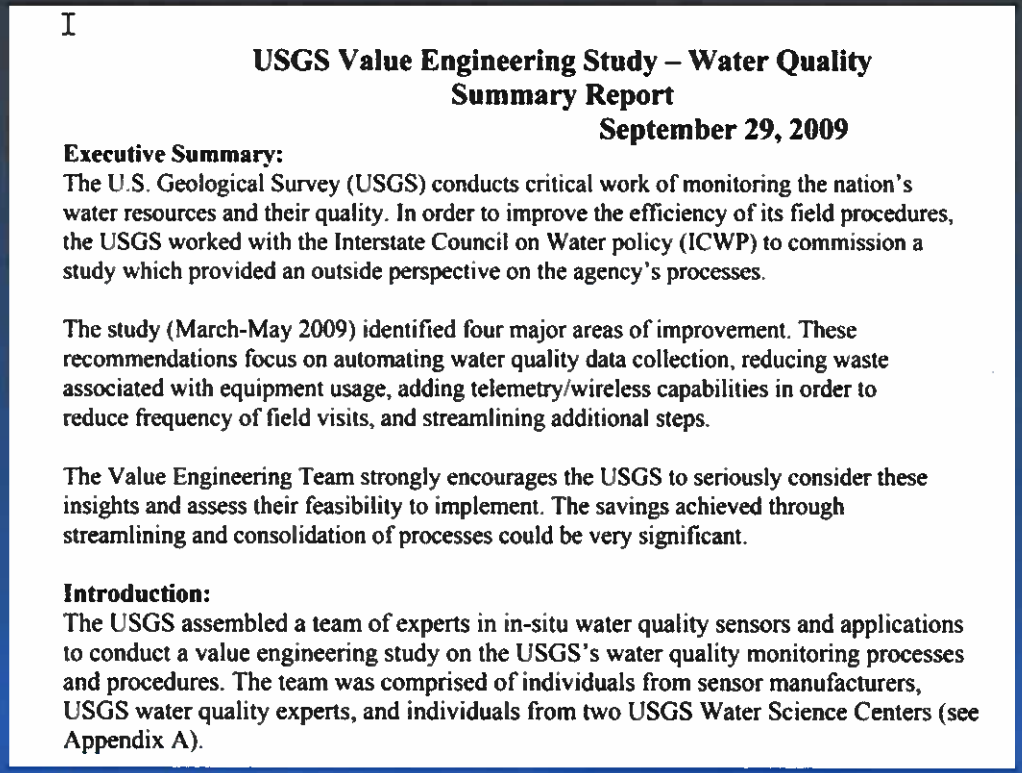
Value engineering studies

- Water Quality: North Carolina and Kansas (2009)
- Surface Water: Maine and Colorado (2010)
- Groundwater: New York, New Mexico, Florida (2012)



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USGS Value Engineering Study – Water Quality
Summary Report
September 29, 2009

Executive Summary:
The U.S. Geological Survey (USGS) conducts critical work of monitoring the nation's water resources and their quality. In order to improve the efficiency of its field procedures, the USGS worked with the Interstate Council on Water policy (ICWP) to commission a study which provided an outside perspective on the agency's processes.

The study (March-May 2009) identified four major areas of improvement. These recommendations focus on automating water quality data collection, reducing waste associated with equipment usage, adding telemetry/wireless capabilities in order to reduce frequency of field visits, and streamlining additional steps.

The Value Engineering Team strongly encourages the USGS to seriously consider these insights and assess their feasibility to implement. The savings achieved through streamlining and consolidation of processes could be very significant.

Introduction:
The USGS assembled a team of experts in in-situ water quality sensors and applications to conduct a value engineering study on the USGS's water quality monitoring processes and procedures. The team was comprised of individuals from sensor manufacturers, USGS water quality experts, and individuals from two USGS Water Science Centers (see Appendix A).

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Value engineering study

Automate data collection

Reduce waste

Add telemetry/wireless

Streamline additional steps

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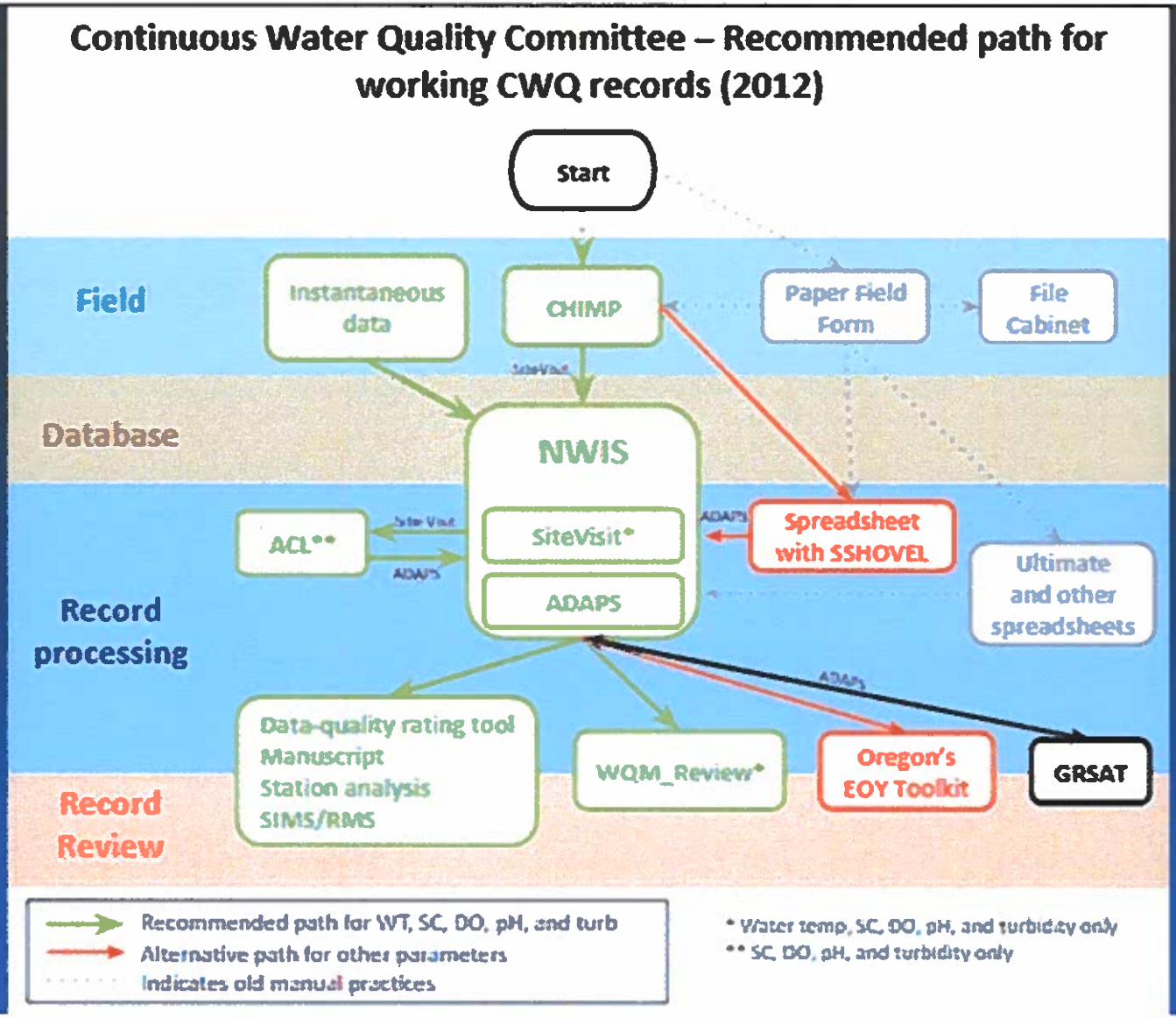
CWQ records workflow



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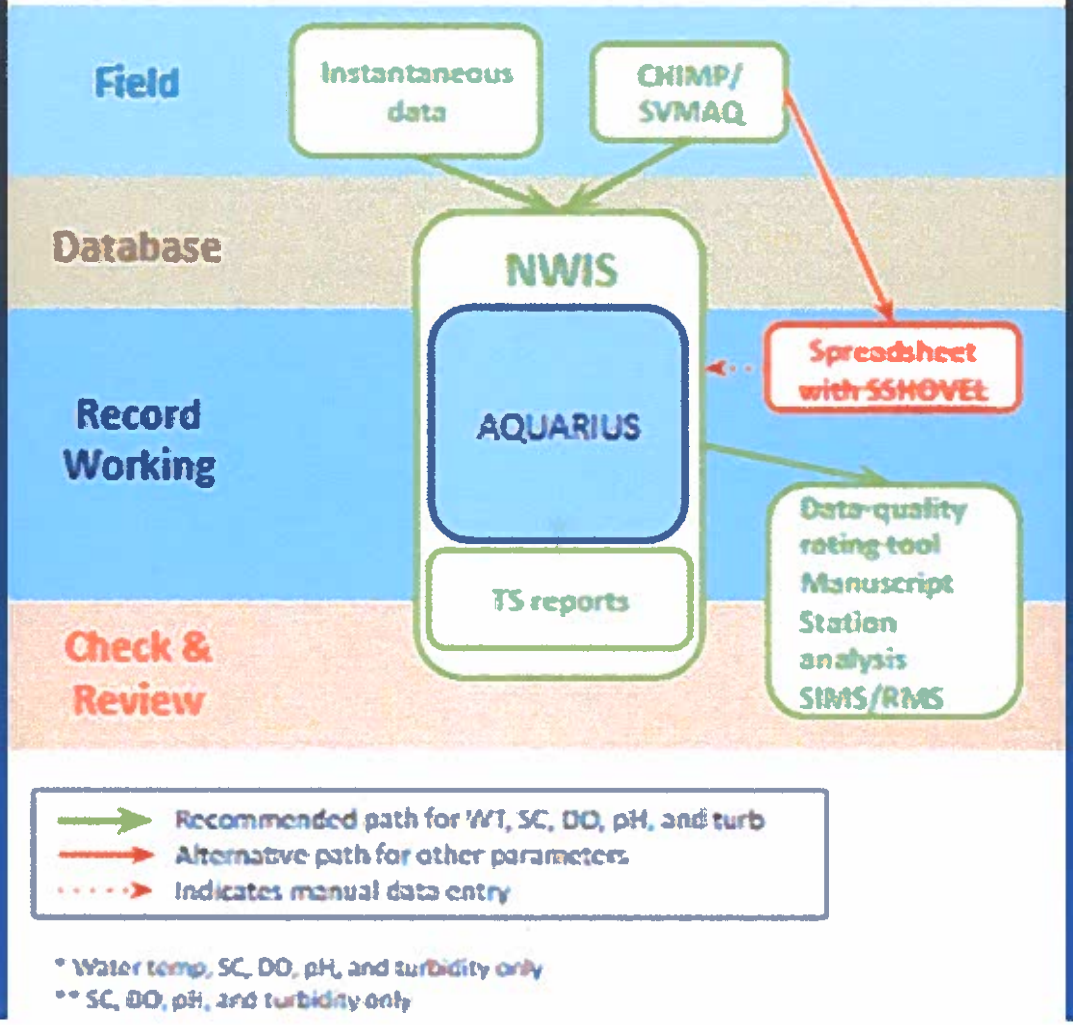
CWQ records workflow

Continuous Water Quality Committee – Recommended path (2017)



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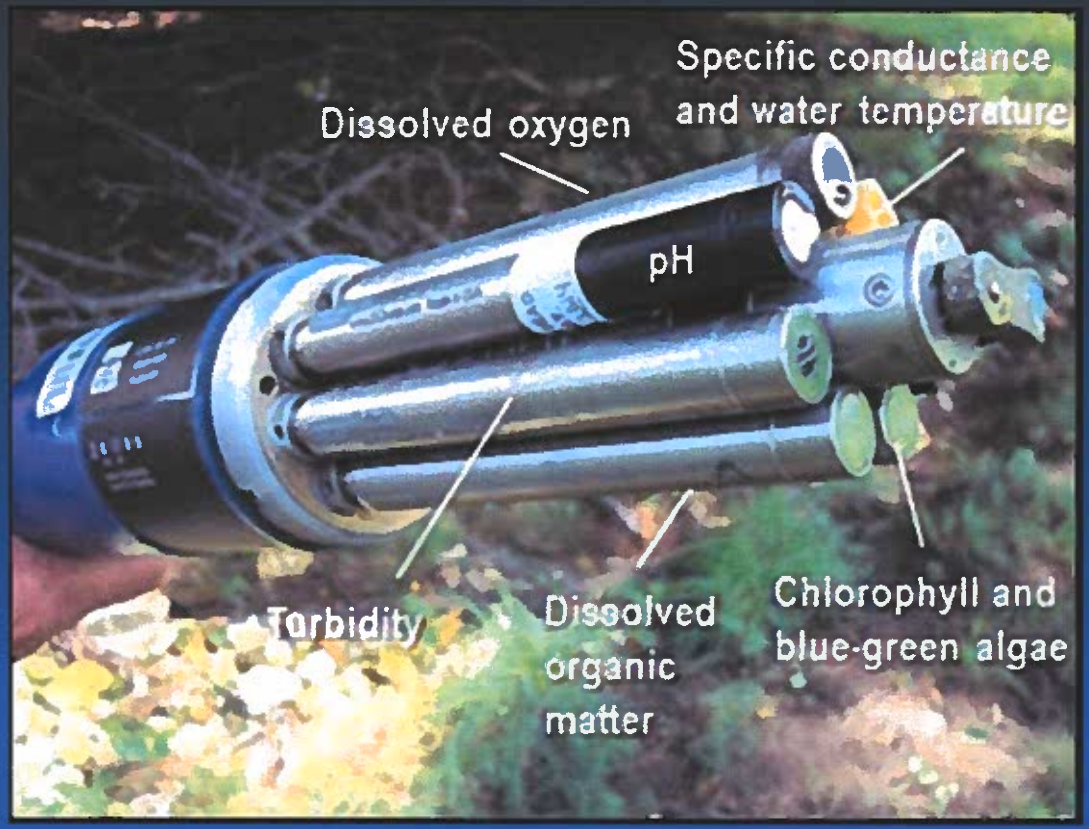
Recent Changes

- Sensors (ongoing)
  - Better quality
  - Antifouling
  - Metadata
  - New parameters
- Swap monitors or sensors (increasing)



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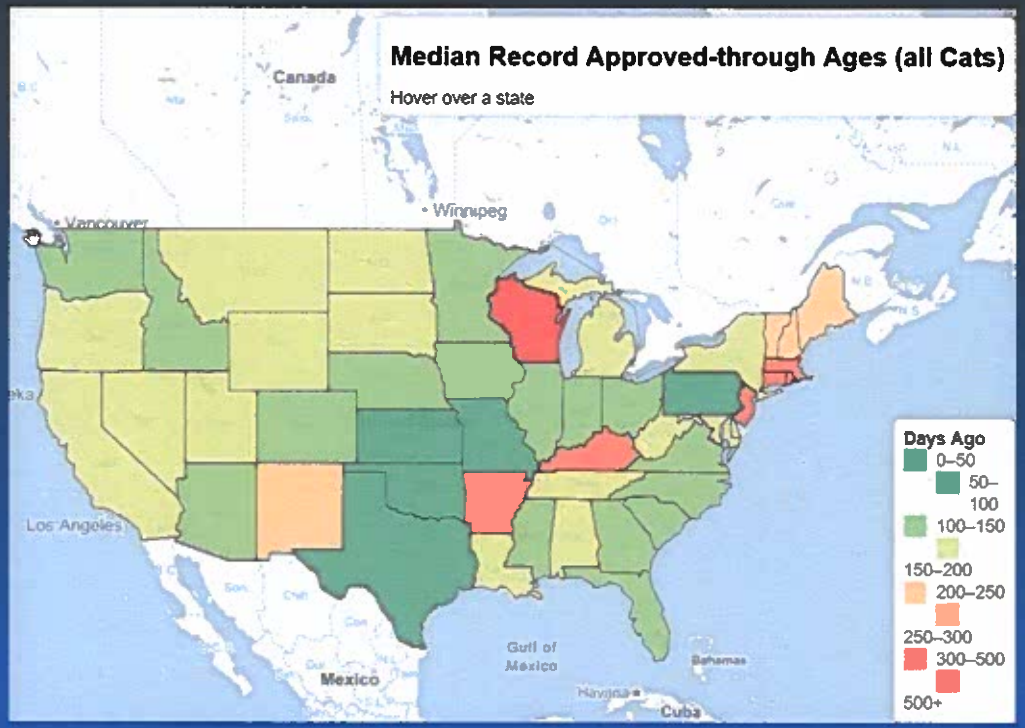
Recent Changes

- Continuous Records Processing (2010)
  - Category 1 - 150 days
  - Category 2 – 240 days
  - Category 3 – indefinite



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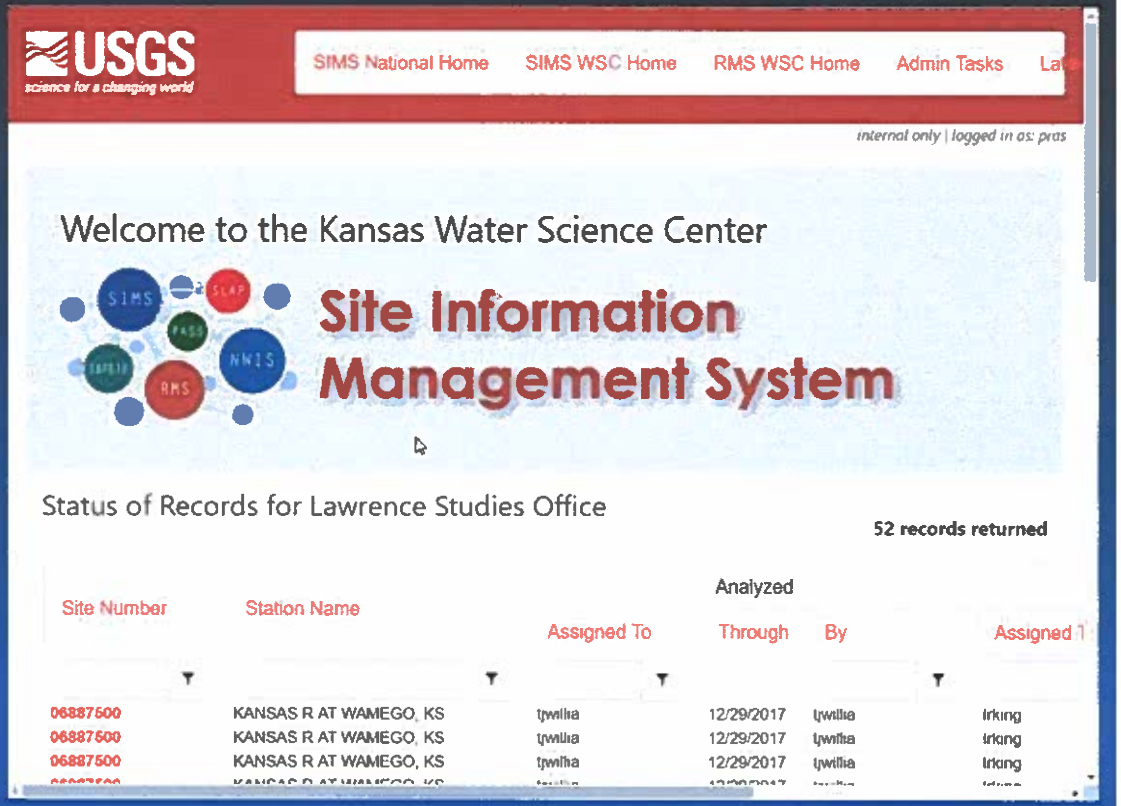
Recent Changes

- AAA process (2017)
  - Analyze
  - Approve
  - Audit
- Records management System update (2017)



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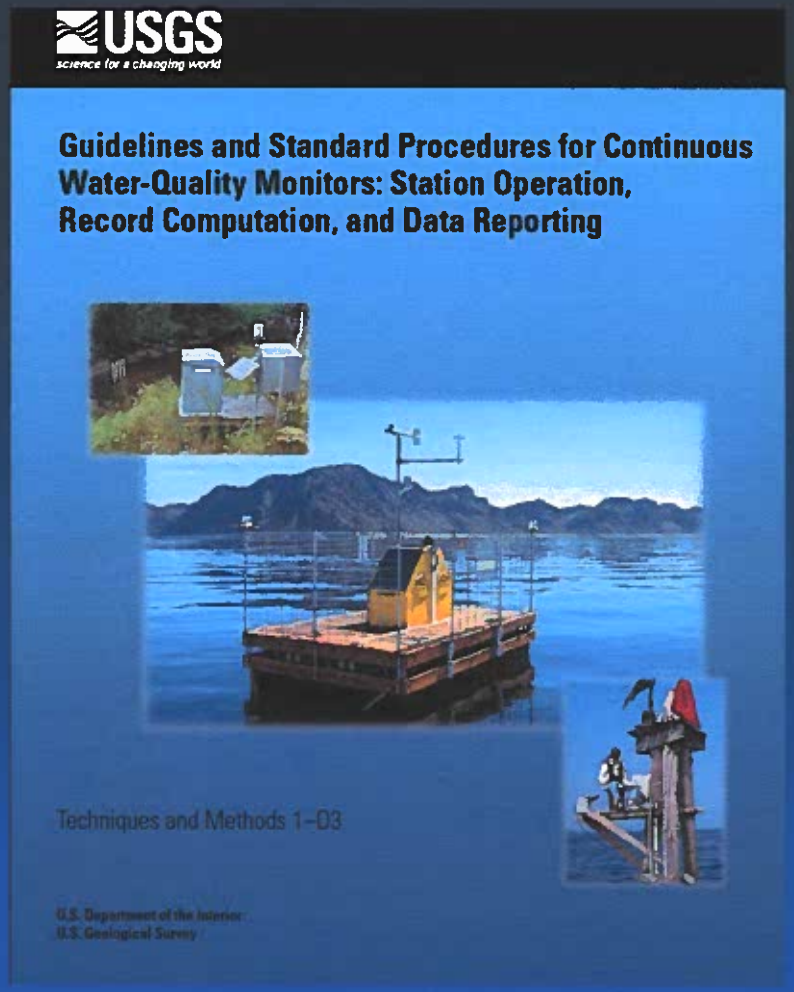
USGS TM1D3 (2006)

- Water-Quality Monitoring Station Operation
  - Site Selection
  - Monitor Selection
  - Placement of Sensors in the Aquatic Environment
  - Stream Cross-Section Surveys
  - Lake or Estuary Vertical Profiles



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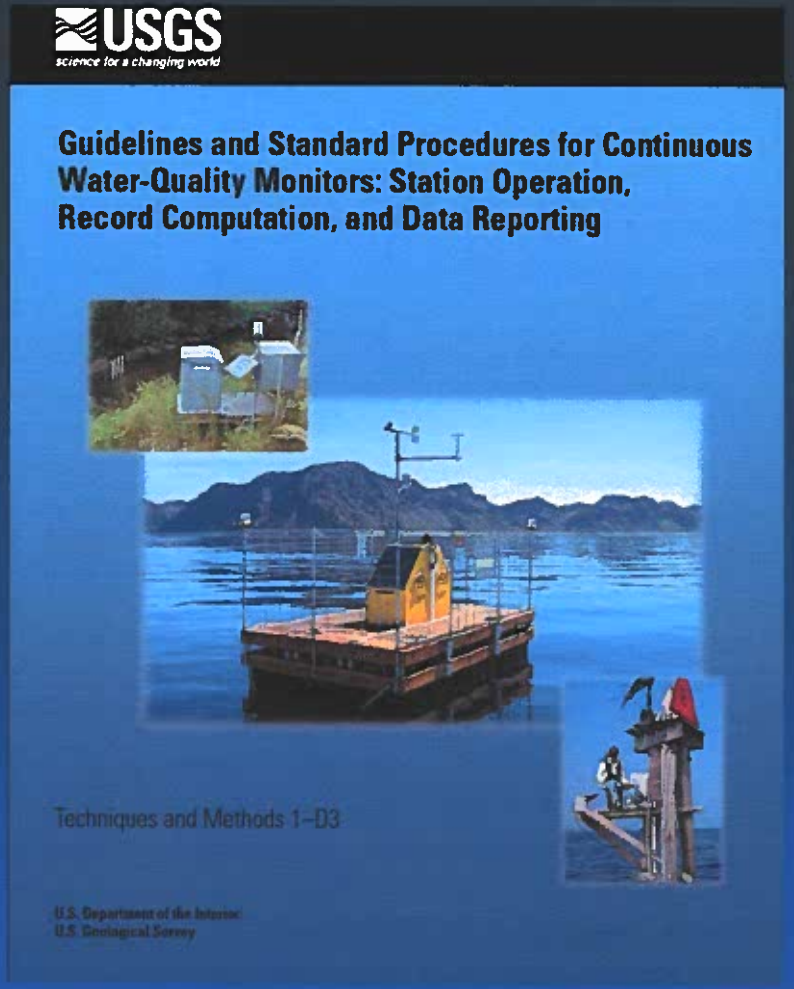
USGS TM1D3 (2006)

- Use and Calibration of Field Meters
- Monitor Operation and Maintenance
- Record Computation
  - Data-Processing Procedures Preparation of the Review Package
- Data Reporting
- Archiving of Records



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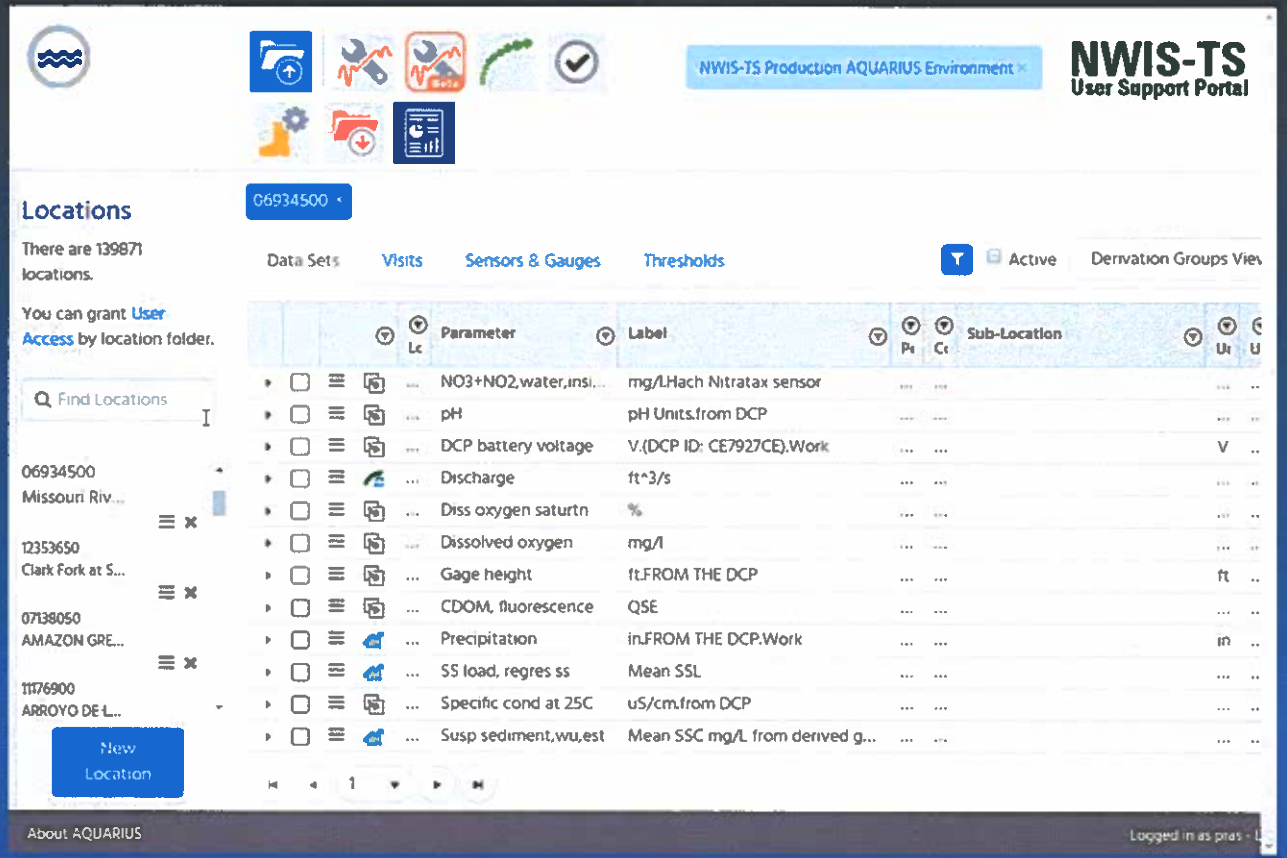
Changes since TM1D3 (2006)

AQUARIUS replaces ADAPS (2017)



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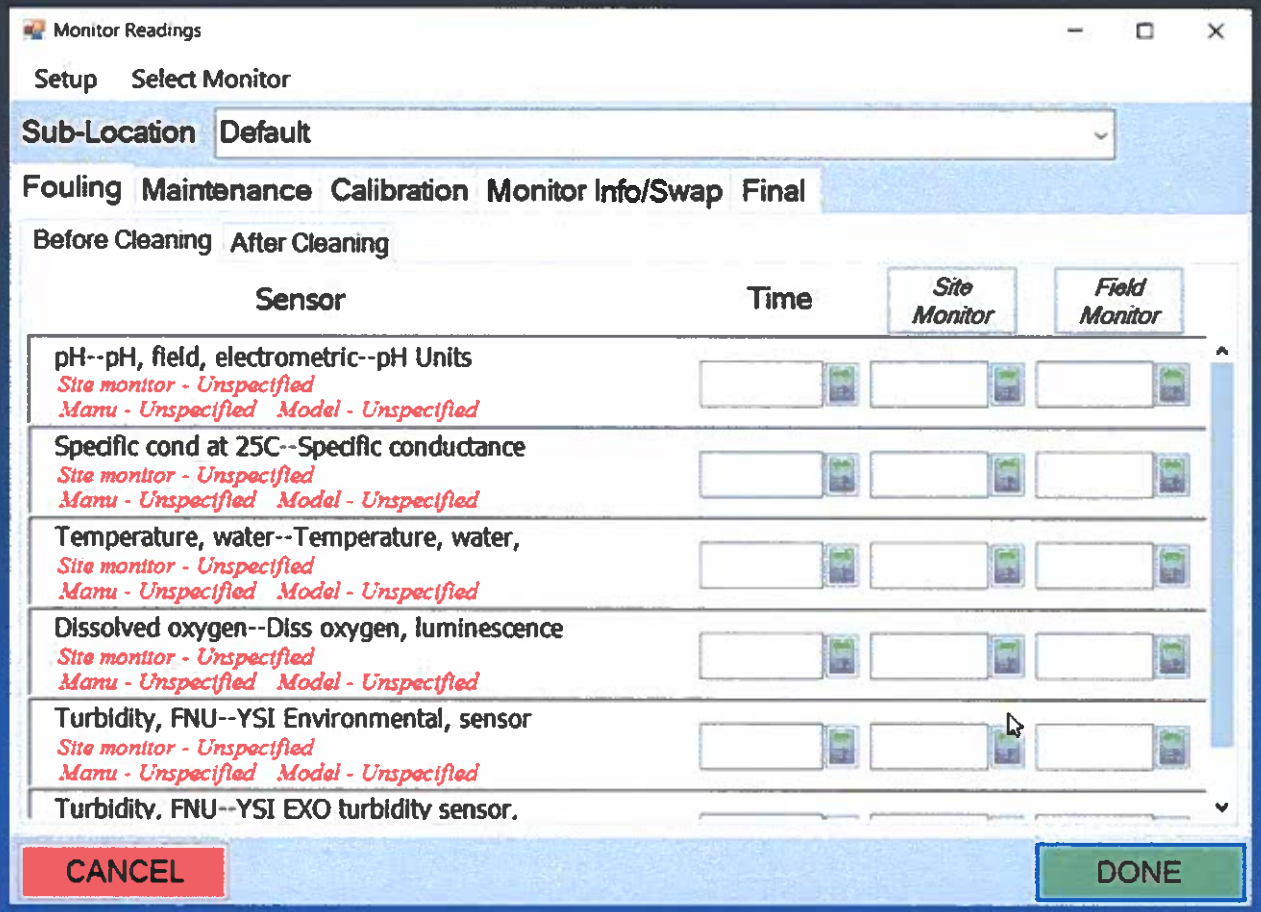
Changes since TM1D3 (2006)

Water quality monitor activity added to USGS field application (SVMAQ, 2018)



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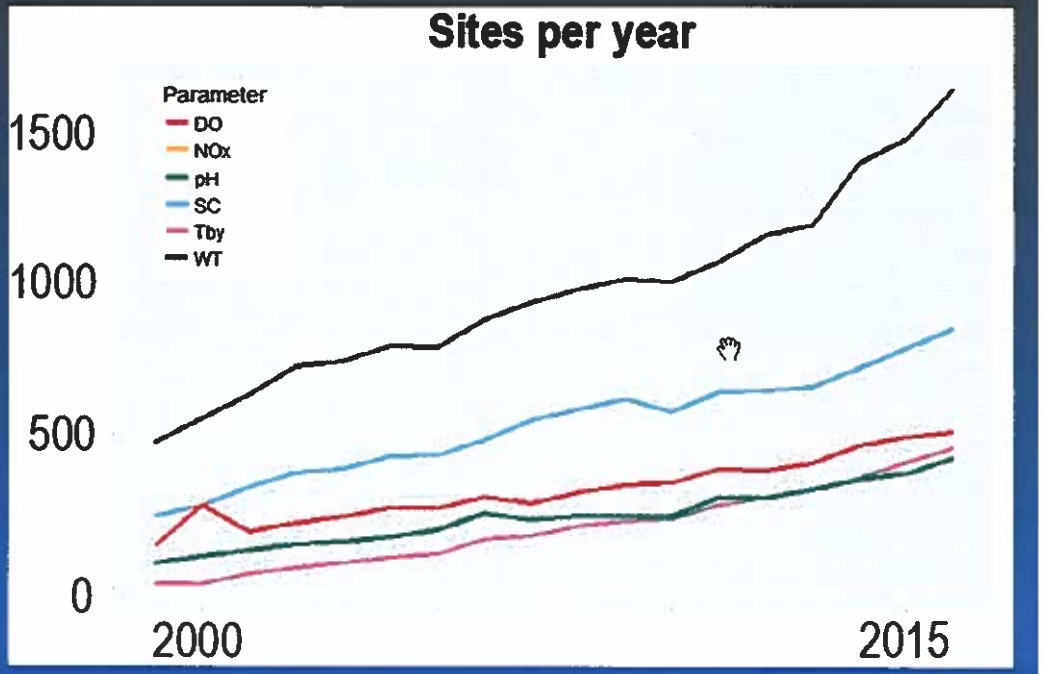
New processors

Processors

- Fill data gap processor to combine DCP and EDL data
- Can use one sensor for values up to a certain point and then another
- Calculation processor can compute surrogates and correct fDOM



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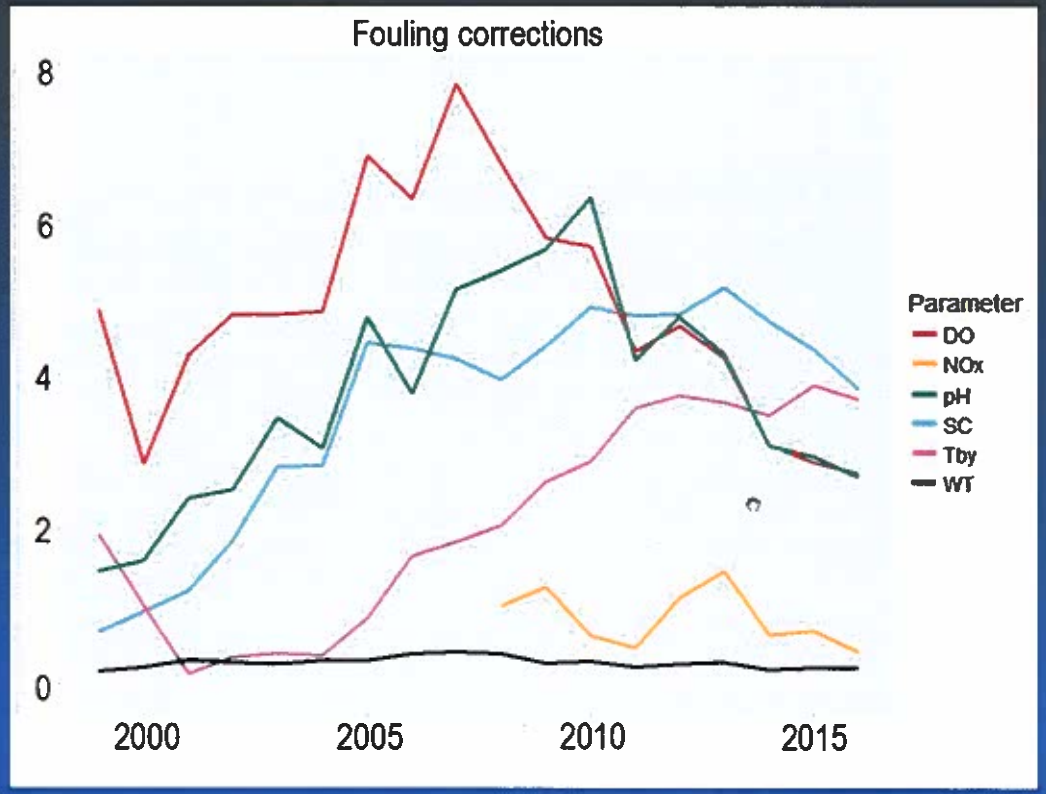
Trends in CWQ corrections

- Fouling and drift corrections
  - Decrease in average number of fouling and drift corrections over the last 4 years due to improvements in:
    - antifouling techniques
    - sensor technology



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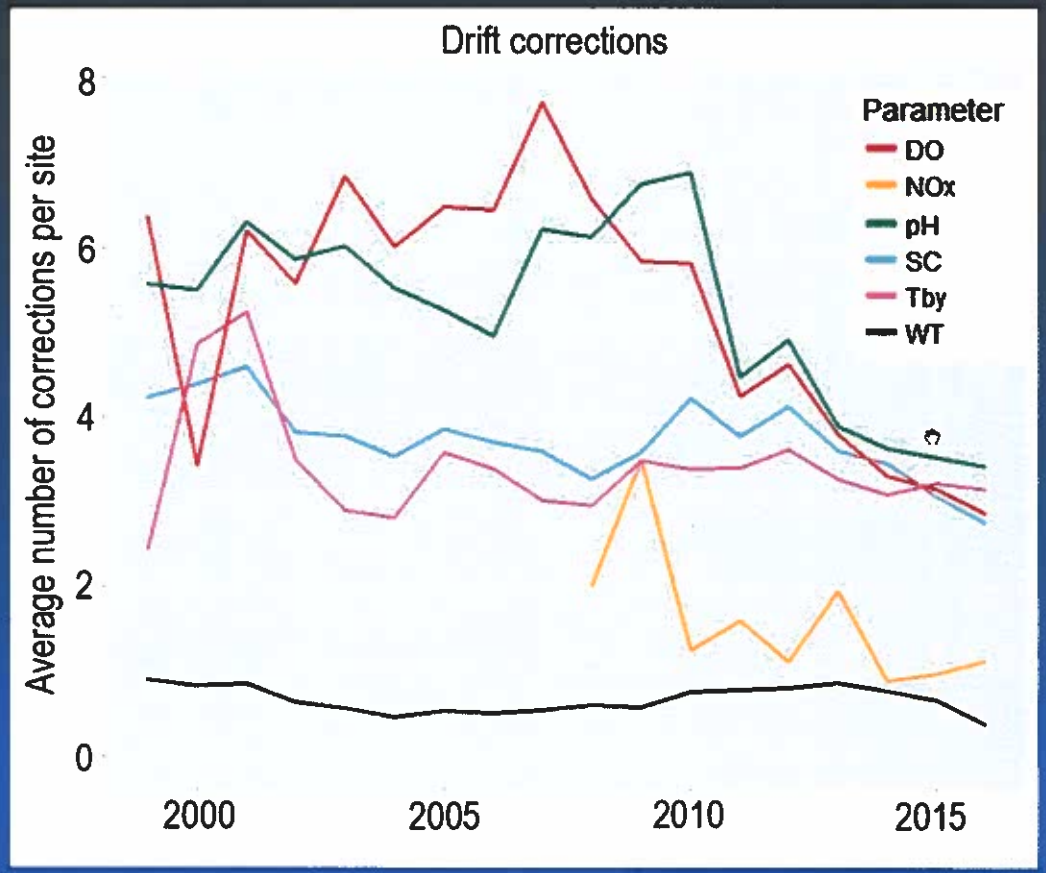
Trends in CWQ corrections

- Dissolved oxygen
  - most corrections until luminescent DO sensors 2007
  - 60% decrease since
- pH
  - corrections have decreased 50% from 2010
- Specific conductance and turbidity
  - corrections have decreased only slightly over the last 3 years



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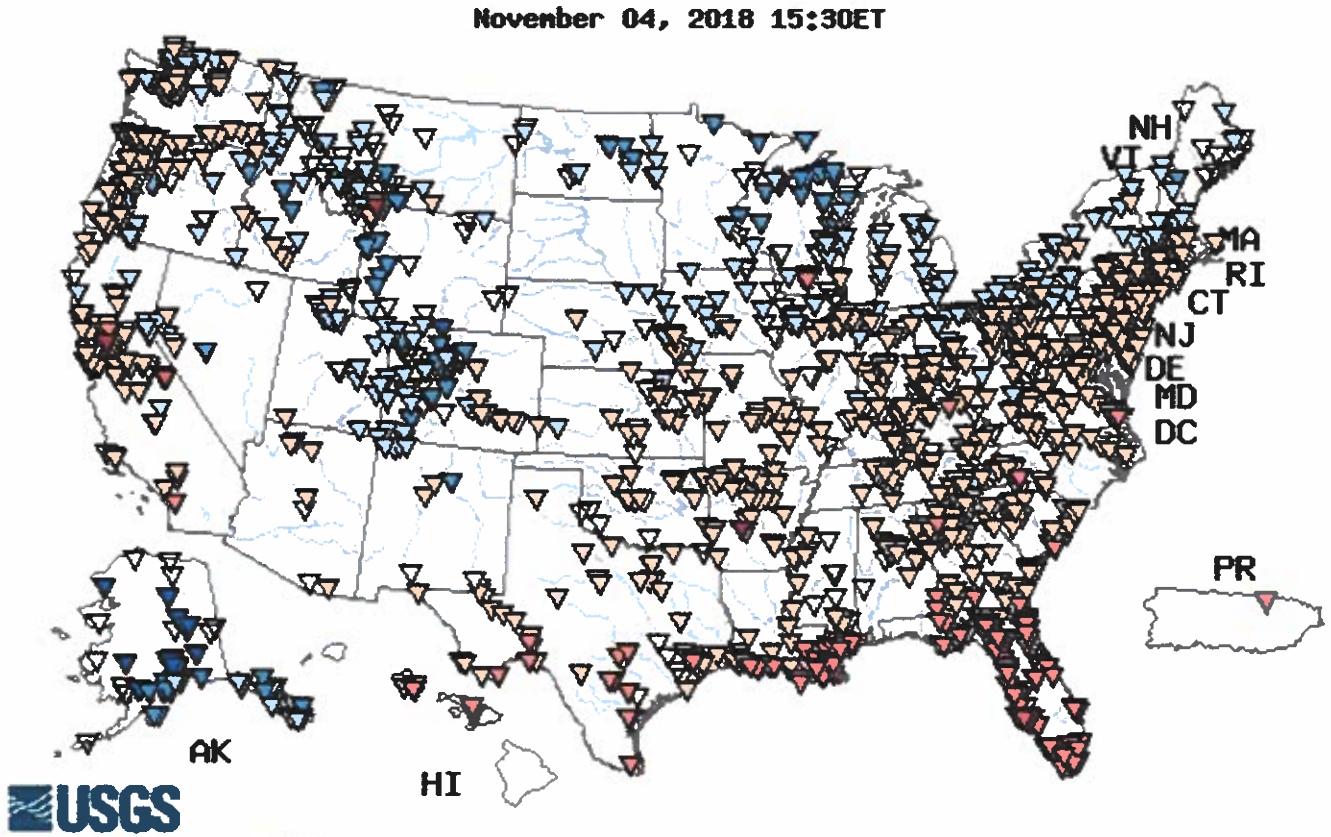
Real-Time Water Temperature, in °C



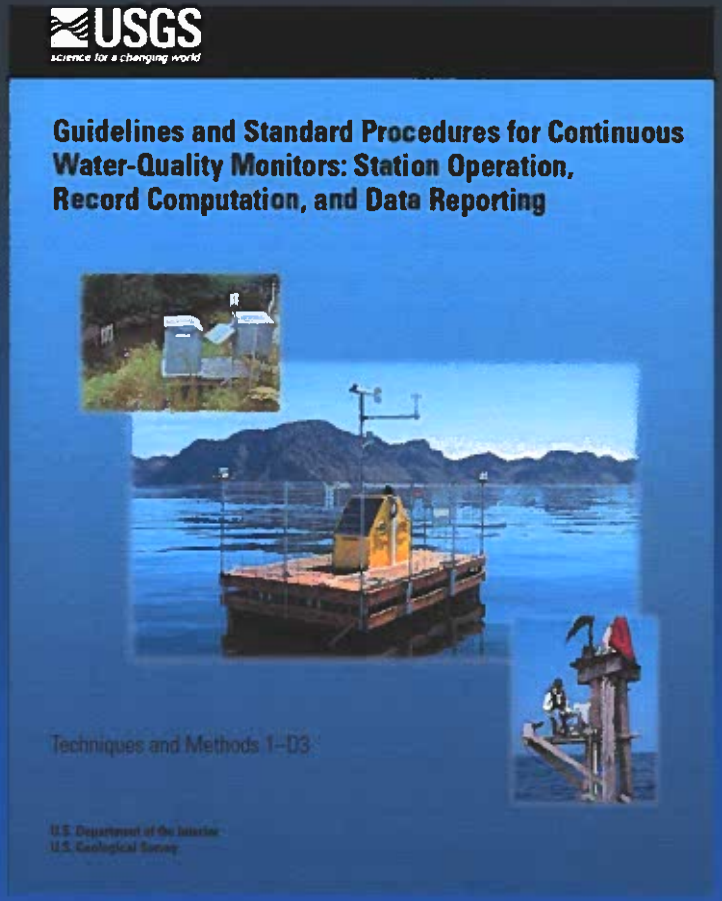
Explanation							
<1	1-4.9	5-9.9	10-19.9	20-29.9	30-35	>35	No Data

Temp | Cond | pH | D.O. | Turb | Nitrate | Disch | Chlorophyll | Surrogates

Future of CWQ monitoring in the USGS

TM1D3 Version 2

- A team is currently writing version 2
- New correction and calibration criteria
- New process for assessing error
- New sensors
- Better guidance on cross-section data
- Published in early 2020



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Future of CWQ monitoring in the USGS

Automate records processing
- Computer works the record
- Personnel review and approve

Modernize field data collection app
- Include all activities
- Wireless communication with loggers and sensors

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Future of CWQ monitoring in the USGS

- Develop more sensor networks
  - Water temperature
  - Sediment
- Determine algorithms to compute uncertainty
  - For every instantaneous value
  - For any measurement

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Future of CWQ monitoring in the USGS

Water Prediction Work Program (2WP)

Advance the capabilities of the National Water Model (NWM) as a National asset supporting the Nation's earth and biological system prediction capability.

USGS science will be an engine, coupled with the NWM, that drives prediction of:

- stream temperature
- surficial processes
- in-stream transport

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Questions?

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http://pubs.usgs.gov/tm/tm3c4/

http://water.usgs.gov/osw/suspended_sediment/time_series.html

http://waterwatch.usgs.gov/wqwatch/

http://nrtwq.usgs.gov

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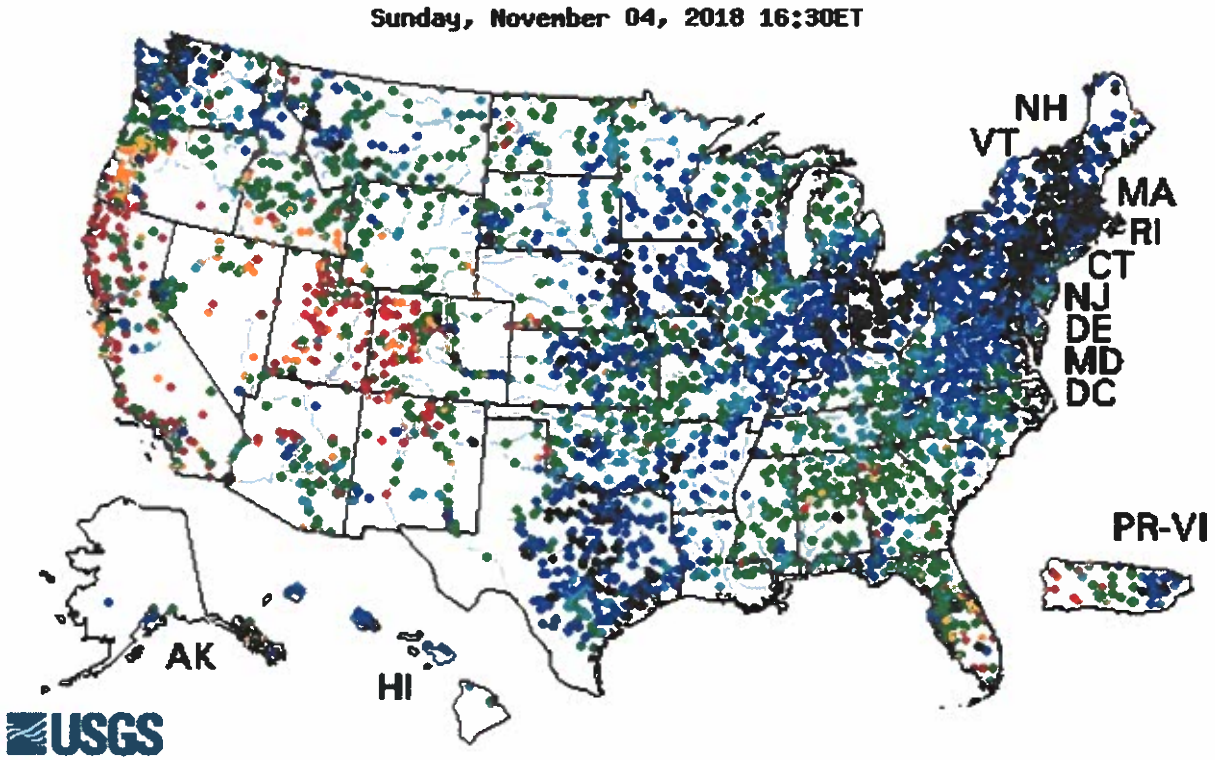
Real-Time Discharge, in cfs



Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

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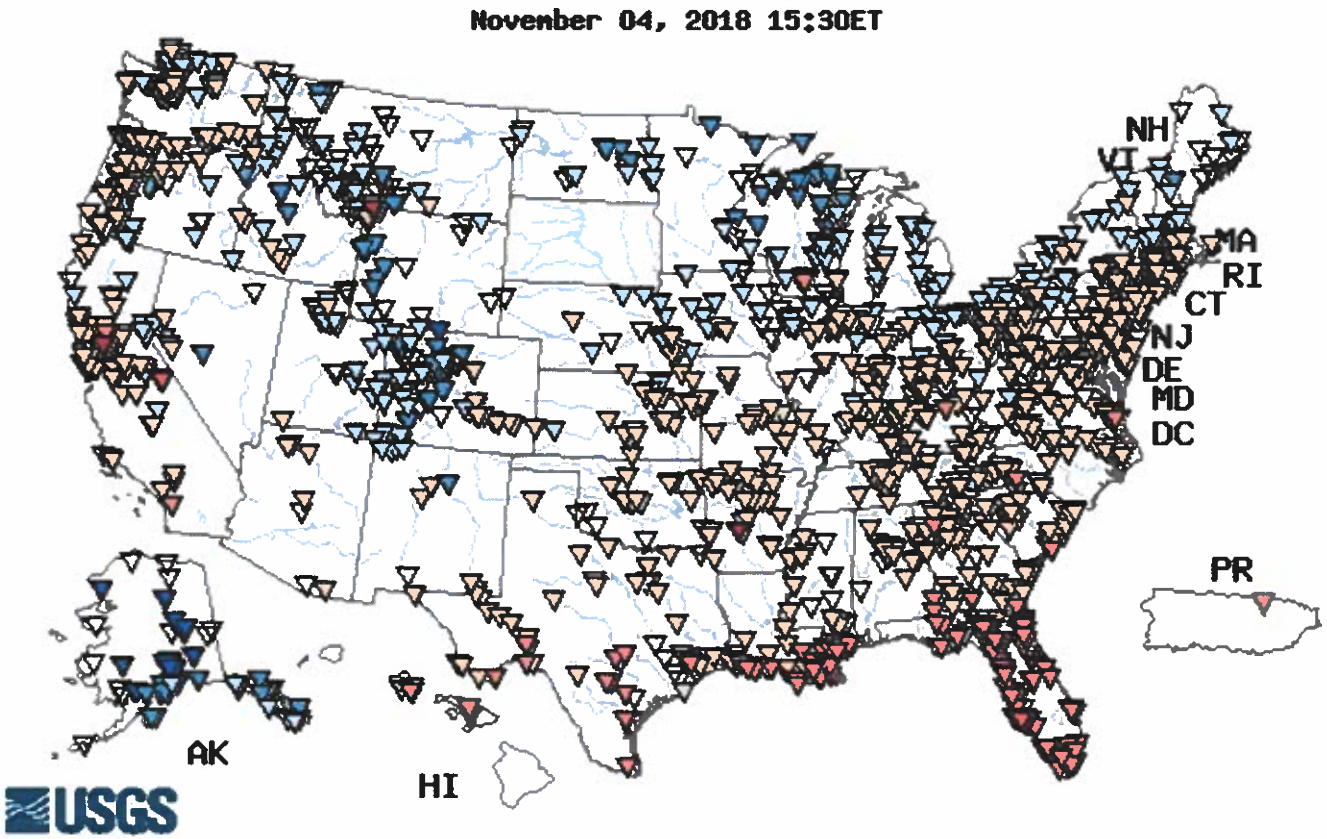
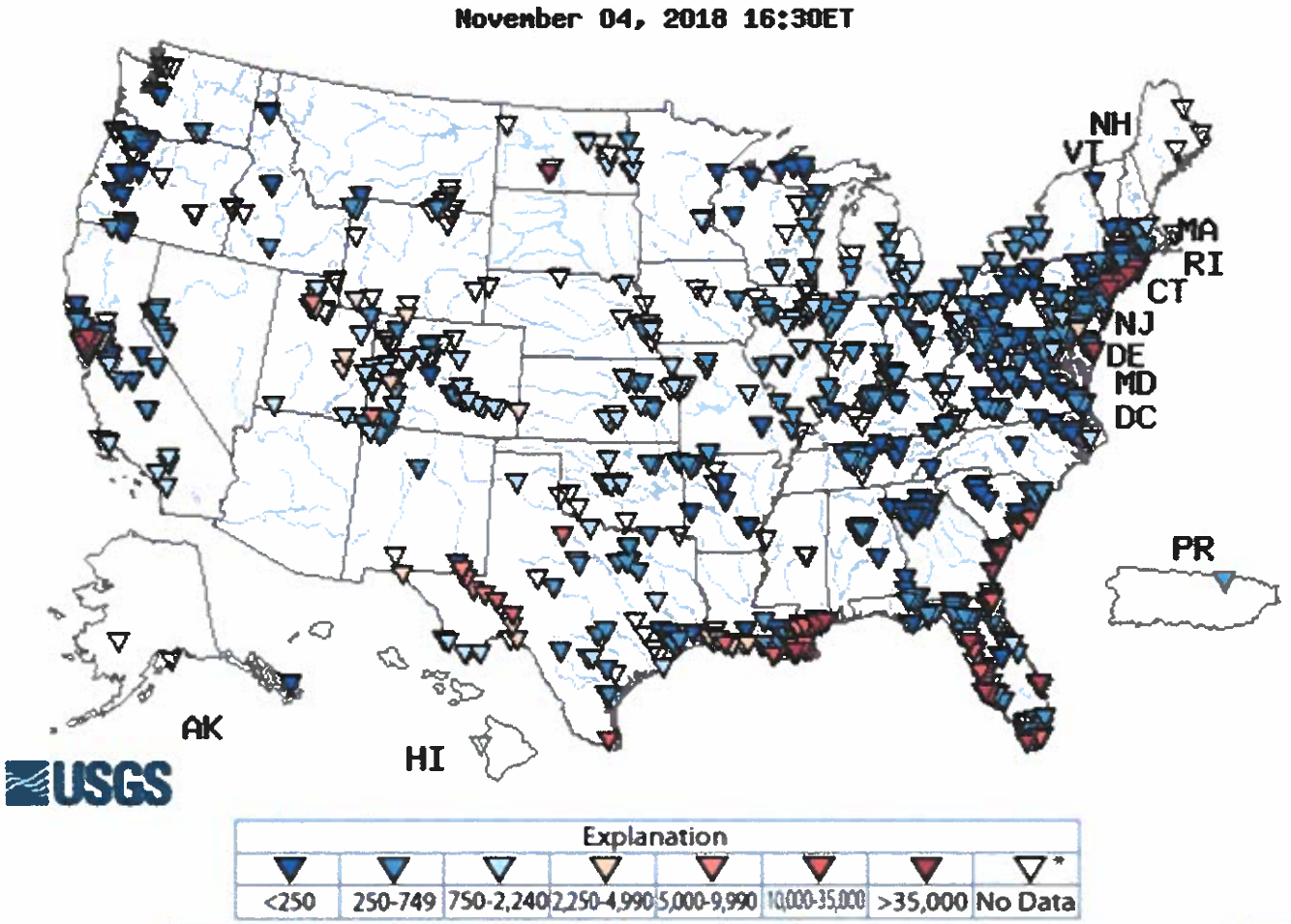
Temp | Cond | pH | D.O. | Turb | Nitrate | Disch | Chlorophyll | Surrogates

Real-Time Water Temperature, in °C

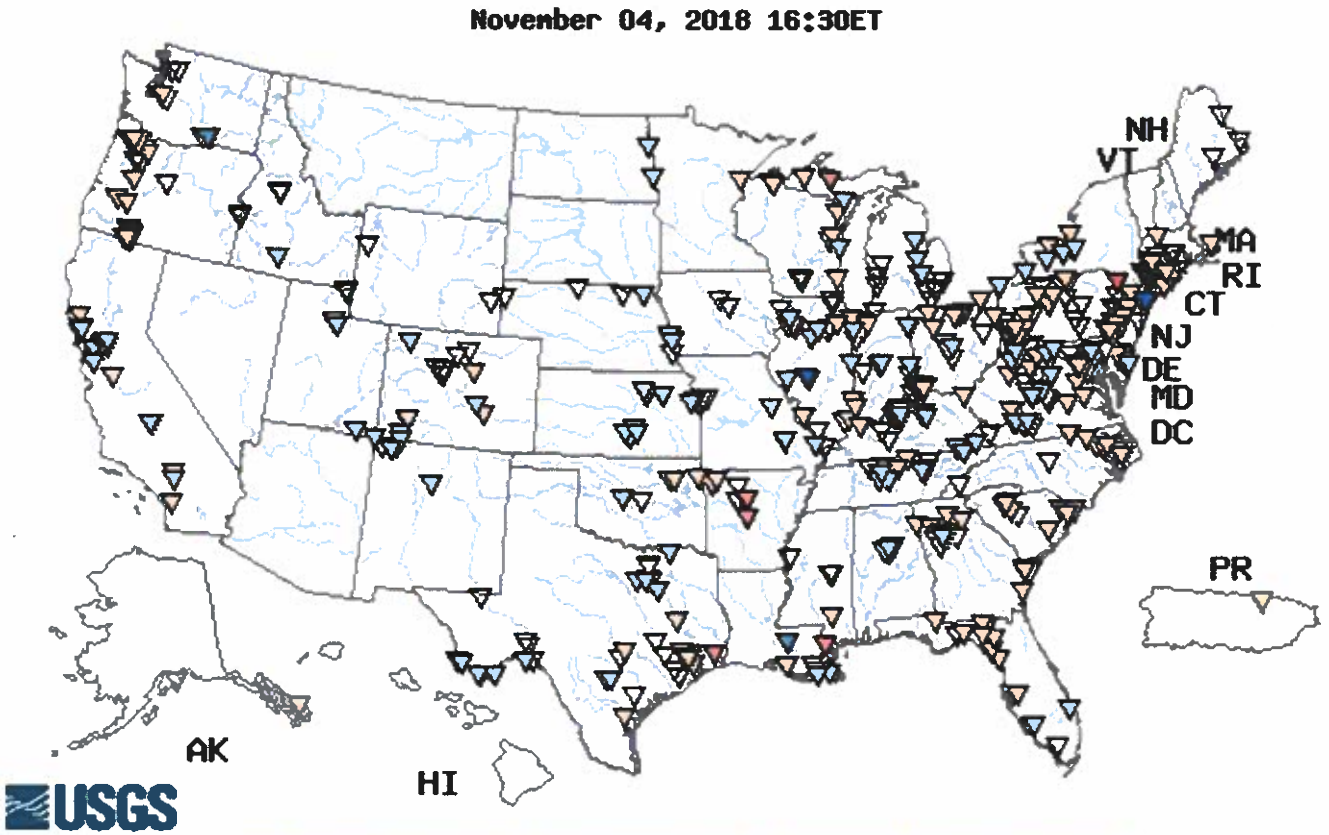


Real-Time Specific Conductance, in µS/cm



Temp | Cond | pH | D.O. | Turb | Nitrate | Disch | Chlorophyll | Surrogates

Real-Time pH, field, in standard units



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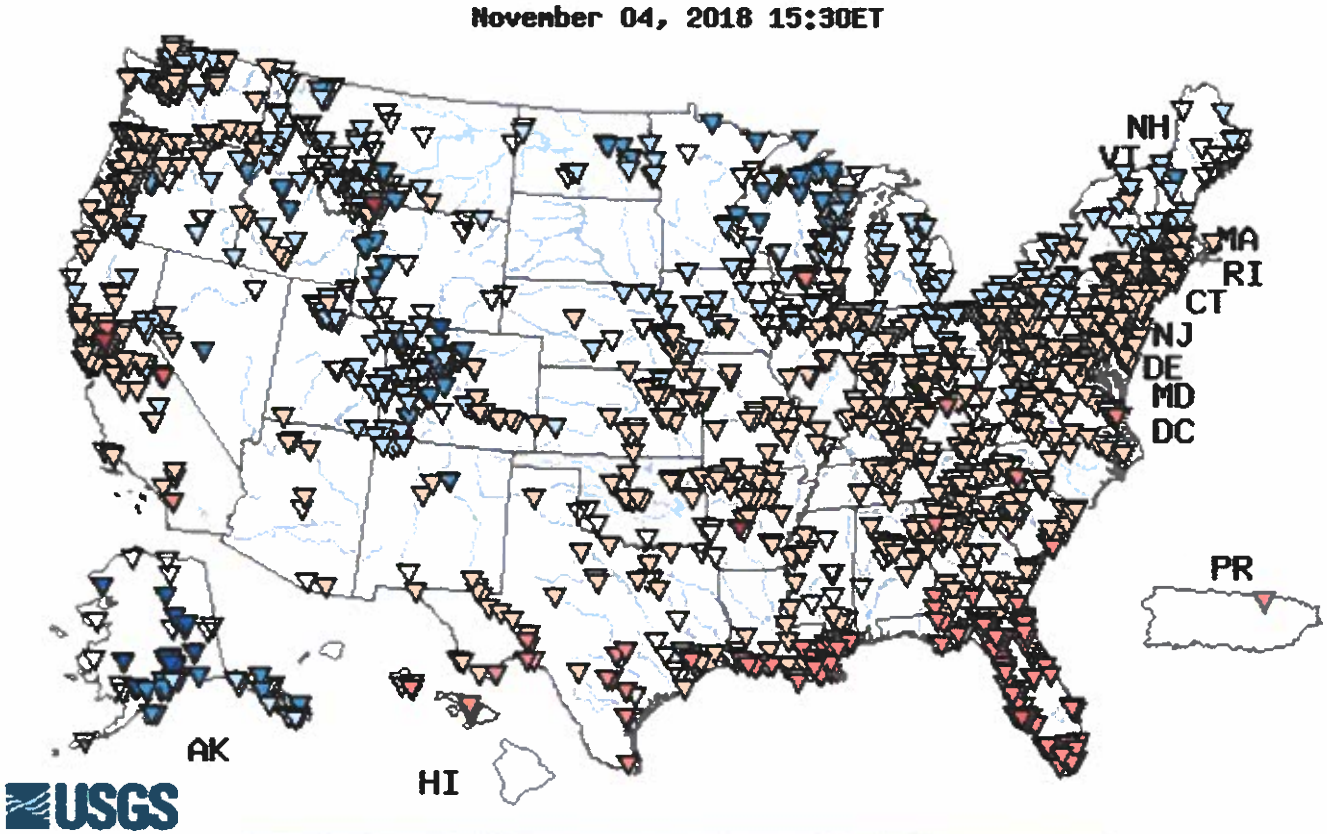
Real-Time Water Temperature, in °C



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