Overview of Online Sensors

Who, What, Why?

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Definitions

- Inline: Instantaneous measurements taken directly in the process line (e.g., *in situ*) using a probe or sensor
- Online: Discrete sample measurement (e.g., a grab sample) collected using automated sampling techniques and measured by automated versions of traditional methodologies.
- However, “online” can also refer to relaying data generated by either approach above over the internet, or even making the data available instantaneously.
- Confused yet? You’re not alone!

Example Inline Probes

- Electrochemical or photochemical probes are readily available for measuring:
  - Nitrate/nitrite
  - pH
  - Dissolved oxygen
  - Conductivity
- Many of these probes can combine temperature measurement into the same device.

Commercially Available Probes

Nitrate/nitrite *(Hach)*

pH and temperature *(Hach)*

Dissolved oxygen and temperature *(Hach)*

Conductivity *(Hach)*

Commercially Available Probes

Ammonia *(YSI)*

Chloride *(YSI)*

Chlorophyll *(YSI)*

Numerous other probes are available from these and other vendors.

Example Online Analyzers

Commercially available analyzers for total organic carbon, plus other analytes (Shimadzu on the left, and Hach on the right). Examples only, other manufacturers exist as well.

Current EPA Policy of Use of Sensors and Analyzers for Compliance Monitoring

- Current Office of Water policy dates to the 1980s
- Established by Bob Booth and Bill Telliard as:

  "If technology is the same as the approved laboratory technology, then it could be used for regulatory reporting without the need for a new method approval"

Examples of Technologies used based on the Current EPA Policy

- Alkalinity
- Ammonia
- Biochemical Oxygen Demand
- Chemical Oxygen Demand
- Chlorine
- Conductivity
- Dissolved Oxygen
- Fluoride
- Hardness
- Ozone
- pH
- Phosphorus
- Silica
- Sulfite
- Temperature
- Total Organic Carbon
- Turbidity

Emerging Technologies that might be Transferred

- Cyanide
- Nitrate/nitrite
- Suspended solids
- Total organic carbon as a surrogate for BOD
- Total Kjeldahl nitrogen
- Total nitrogen

Incorporating Sensors and Analyzers into Current Regulatory Paradigm

- Seek approval in 40 CFR 136 via the Alternate Test Procedure process at 40 CFR 136.6
- Demonstrate that the underlying chemistry and determinative steps are similar to a existing method approved at 40 CFR 136
- Or apply for approval as a “new method” when the technology differs from approved methods, but measures the same parameter

Vendor vs. Permittee Responsibilities

- Vendors can:
  - Develop technology and demonstrate its general performance and applicability
  - Examine matrices from a variety of industries
- Permittee must:
  - Demonstrate that their implementation meets established method performance criteria (initial and ongoing)
  - Optimize the sensor/analyzer placement and analytical frequency relative to their waste stream
  - Validate the data for their discharge
- Ultimate responsibility rests on the permittee

Implementation Challenges

- Knowledge gaps exist:
  - “We’ve never done/allowed that before”
  - “We do not understand the technology”
- One-size-fits-all approach to quality control in fixed lab methods may not transfer to sensors or analyzers
  - May not be enough QC, or
  - May be too much QC
- Results from sensor/analyzer may never match grab sample and laboratory analysis
  - But sensor/analyzer results may better reflect the true nature of the discharge

How Do We Move Forward?

- Similar potential mechanisms already exist, including:
  - Alliance For Coastal Technologies
  - EPA Continuous Monitoring Data Strategy Workgroup
  - ASTM D-19 Committee

Alliance For Coastal Technologies (ACT)

- The Congress established ACT in 2000.
- It is funded by NOAA.
- It is a partnership of research institutions, resource managers, and private sector companies.
- Funded by NOAA, but managed by the University of Maryland Chesapeake Bay Biological Laboratory

ACT's Mission

- ACT is committed to providing the information required to select the most appropriate tools for studying and monitoring coastal environments.

http://www.act-us.info

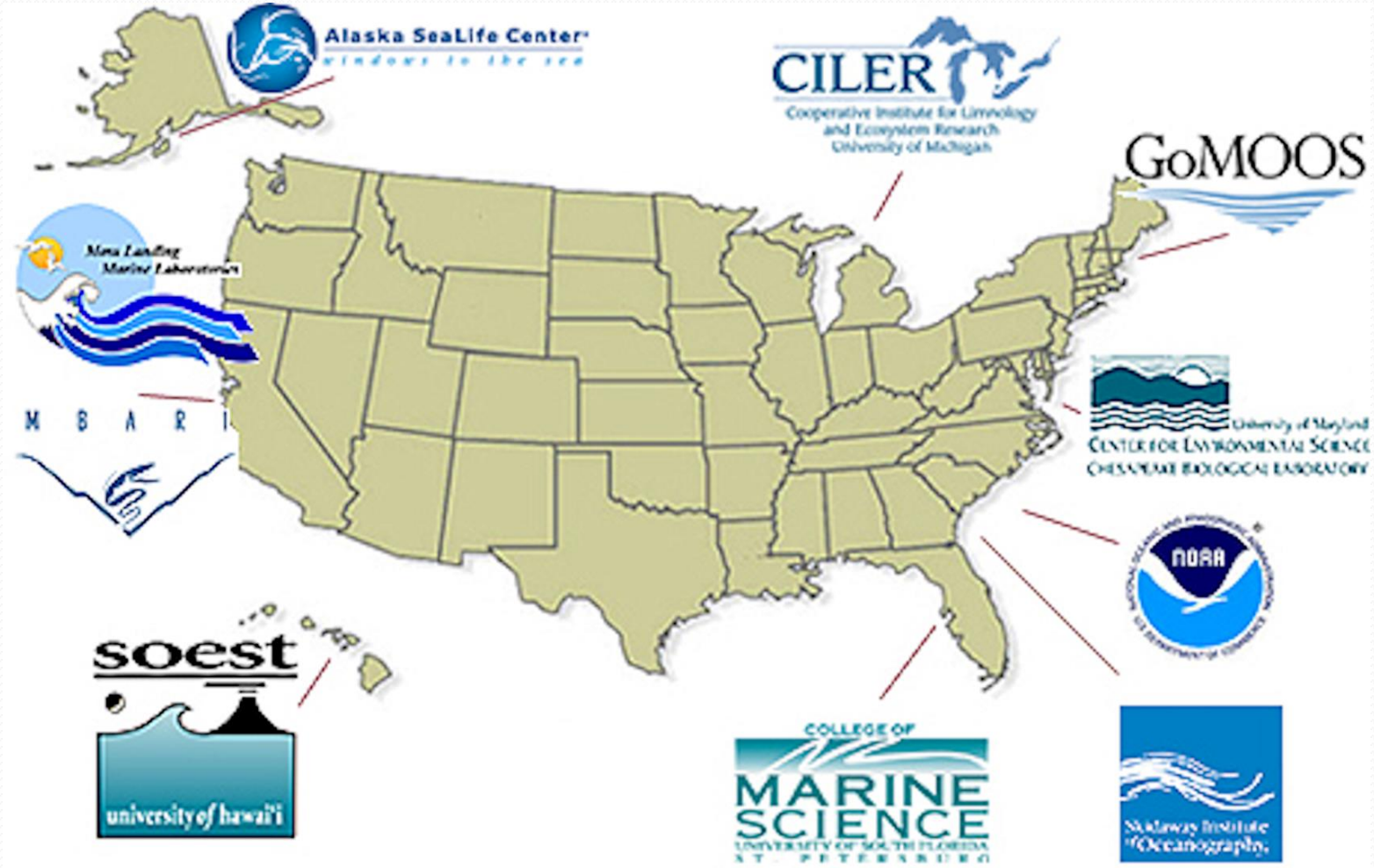
ACT's Priorities

- Transition emerging technologies to operational use rapidly and effectively
- Maintain a dialogue among technology users, developers, and providers
- Identify technology needs and novel technologies
- Document technology performance and potential
- Provide a foundation for the US Integrated Ocean Observing System

ACT's Services

- ACT is a third-party testing place for quantitatively evaluating the performance of new and existing coastal technologies in the lab and under diverse environmental conditions.
- ACT is designed to serve as an unbiased, third-party actor for evaluating sensors and sensor platforms for use in coastal environments.
- Currently, there are eight ACT partner institutions around the nation that possess coastal technology expertise and that also represent a broad and diverse range of environmental conditions for testing.

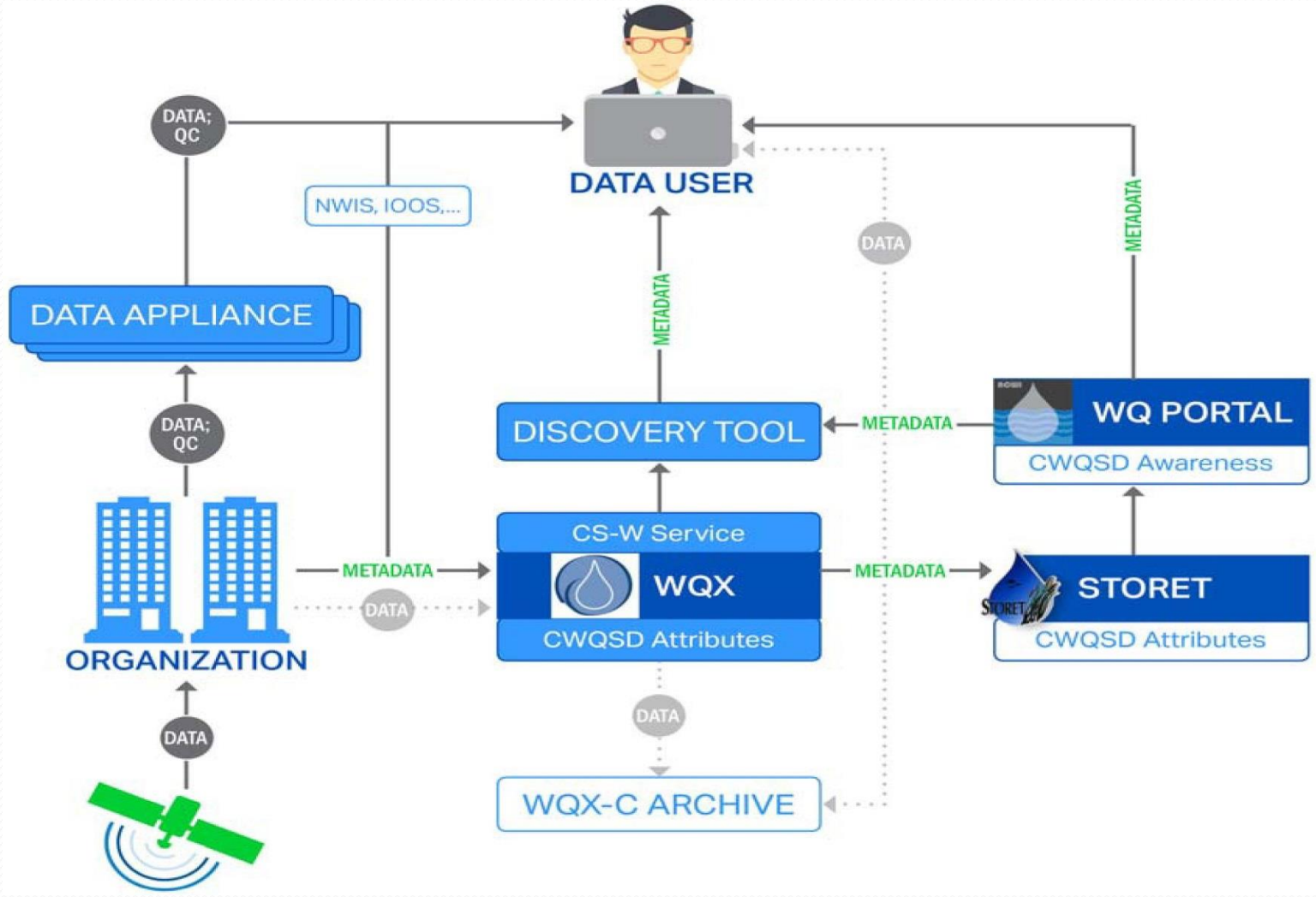
ACT Partner Institutions



EPA Continuous Monitoring Data Strategy Workgroup

- The Agency has put together a workgroup to develop procedures to deal with the vast amount of data that can be generated from continuous online monitoring.
- Sensors will be logged into the Water Quality Exchange (WQX)
- The workgroup has reviewed the existing alternatives:
  - a. Status Quo: WQX, STORET, Water Quality Portal
  - b. USGS/NWIS
  - c. USEPA/Air/Now
  - d. National Weather Service
  - e. NOAA/I00S

EPA's Draft Data Sharing Strategy



Workgroup Discussions

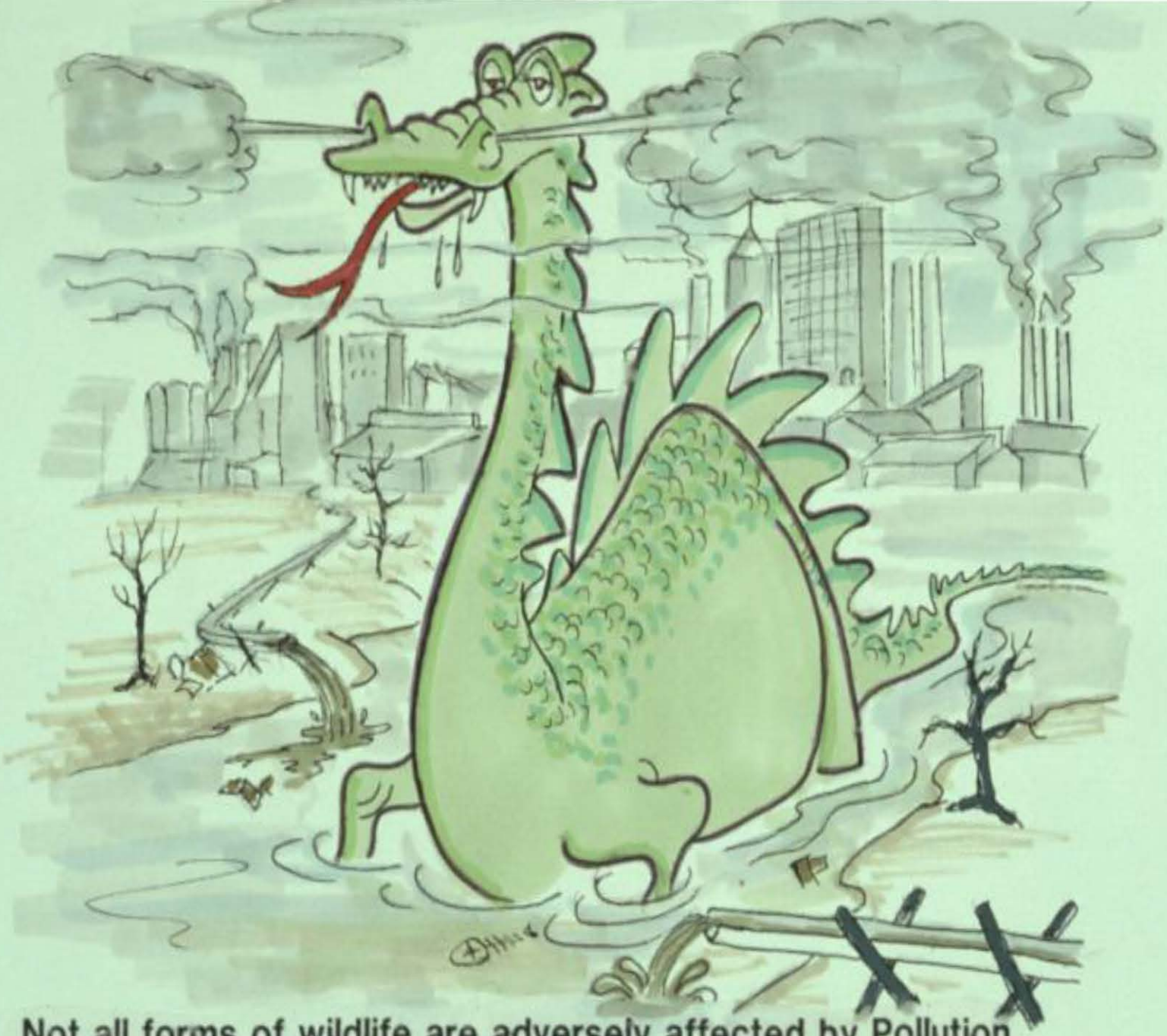
- There is considerable and ongoing discussion about what data are to be archived.
- At present, there are two method types under discussion:
  1. Operational data - i.e. grab sample results that have some immediacy, and would probably have a low QA component. (Low "QA data" has not yet been defined.)
  2. Assessment data - This would probably be a sample collected over time either by sensor or probe, and it would require high-quality QA. (Again, "high quality QA" has not been defined.)
- A draft proposal on the data management protocol is being developed.

EPA Office of Water, Office of Science and Technology

- OST organized a meeting in April 2015 to share information about online continuous monitoring technologies, to share experience from existing users of monitoring systems and to discuss the next steps needed to move this technology forward.
- In particular, there was an open-panel EAD Workshop, with over thirty participants, to present their various views centered upon possibilities for developing an approach to formally incorporate online continuous monitoring into the Office of Water's NPDES program.

ASTM Water Committee D19 Sensor Development and Validation

- The D19 Committee held a technical workshop on sensor deployment, data analysis, and validation in January 2012.
- ASTM D19.03 is developing a Standard Practice for the deployment of sensors in open water bodies
- Also developing protocols for validating sensors and demonstrating comparability to facilitate use for compliance monitoring and as field methodologies



Not all forms of wildlife are adversely affected by Pollution

ASTM Water Committee D19 Sensor Workshop

Tentatively scheduled for June 2016 in Bellevue, WA.

Details still being worked out