WATER QUALITY ASSESSMENT FRAMEWORKS FOR THE 21ST CENTURY
CONNECTING THE DOTS AND ADAPTING TO CHANGE

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WATER QUALITY PRIORITIES

• NUTRIENTS
• HARMFUL ALGAL BLOOMS
• SEDIMENTS
• STORM WATER
• EMERGING CONTAMINANTS
EXISTING US NATIONAL FRAMEWORKS

• USGS - NAWQA
  • HTTP://WATER.USGS.GOV/NAWQA/

• USEPA / STATES - NATIONAL AQUATIC RESOURCE SURVEYS
  • HTTP://WATER.EPA.GOV/TYPE/WATERSHEDS/MONITORING/AQUATICSURVEY_INDEX.CFM
NATIONAL WATER QUALITY ASSESSMENT PROGRAM

STRENGTHS
• ROBUST INTEGRATED NETWORK
• STANDARDIZED COLLECTION AND ANALYTICAL METHODS
• LINKED TO FLOW
• GOOD TEMPORAL COVERAGE

LIMITATIONS
• GREATER UNCERTAINTY IN HEADWATERS
• LIMITED SPATIAL COVERAGE *OUTSIDE OF STUDY UNITS
• LIMITED HISTORICAL RECORD (1991)
NATIONAL AQUATIC RESOURCE SURVEYS

STRENGTHS

• PROBABILISTIC DESIGN
• PARTNERSHIP
• NATIONAL COVERAGE
  • SMALL STREAMS
  • LAKES
  • OCEAN
  • WETLANDS
  • LARGE RIVERS
• CONSISTENT METHODS

LIMITATIONS

• LIMITED TEMPORAL DATA
• LIMITED NUMBER OF SITES
• 10 YEAR RECORD WITH 5 YEAR SAMPLING FREQUENCY
LARGE SCALE MODELS

• SWAT / HAWQS
  • HTTPS://EPAHAWQS.TAMU.EDU/

• SPARROW
  • HTTP://WATER.USGS.GOV/NAWQA/SPARROW/

• LONG PERIODS OF RECORD REQUIRED FOR CALIBRATION/VALIDATION WITH THE DEGREE OF UNCERTAINTY RISING WITH THE UPSTREAM DISTANCE FROM THE MONITORING STATIONS.
ADDITIONAL AMBIENT SOURCES

• THE WATER QUALITY PORTAL
  • STORET
  • NWIS
  • HTTP://WATERQUALITYDATA.US/

• CONSORTIUM FOR THE ADVANCEMENT OF HYDROLOGICAL SCIENCE INCORPORATED
  • HTTPS://WWW.CUAHSI.ORG/WDC
Example of using “Big Data” concepts to identify potential hot spots from a combination of discharge information and ambient data.
COMPLIANCE MONITORING

- Current methods focused on grab samples and laboratory analysis
- Drinking water
  - Source water
  - Finished water
- Discharge monitoring
  - Discharge monitoring requirements (DMR) and reports
IN SITU WATER QUALITY SENSOR NETWORKS (EXAMPLES)

- RIVER AND ESTUARY OBSERVATORY NETWORK (CLARKSON)
  - HTTP://WWW.BIRE.ORG/RIVER-AND-ESTUARY-OBSERVATORY-NETWORK/

- INTELLIGENT RIVER (CLEMSON)
  - HTTPS://WWW.INTELLIGENTRIVER.ORG/
IN-SITU SENSORS

STRENGTHS

• LOW COST
• CONTINUOUS SURVEILLANCE
• REAL TIME
• POTENTIALLY FINE SPATIAL RESOLUTION
• STANDARDIZATION POSSIBLE
• HIGH PRECISION
• POLLUTANT FLUXES

LIMITATIONS

• GENERAL PRECISION
• LIMITED SCOPE
• INSTALLATION AND MAINTENANCE COSTS
• METHODS STILL NEED TO BE DEVELOPED FOR REGULATORY USES

Adapted from in-situ water quality monitoring – Philipp Saile GEMS/Water Data Centre
PULLING IT ALL TOGETHER

• CONTINUE TO SUPPORT LONG TERM FIXED STATION MONITORING (NAWQA) TO EXTEND PERIOD OF RECORDS. INCLUDE MORE SENSOR ARRAYS AT THESE STATIONS

• LEVERAGE / INCENTIVIZE DRINKING WATER AND WASTE WATER UTILITIES TO BECOME WATER QUALITY DATA PROVIDERS

• DEVELOP APPROPRIATE ANALYTICAL AND STATISTICAL METHODS FOR INTERPRETING SENSOR DATA – INCLUDE STUDIES ON METHODS OF COMBINING RESULTS FROM DIFFERENT NETWORKS

• CONTINUE TO PUSH FOR IMPROVED SPATIAL COVERAGE ESPECIALLY IN AREAS OF MIXED LAND USE UPSTREAM OF TRADITIONAL FIXED STATIONS

• ESTABLISH INTERNATIONAL WATER DATA AND META DATA STANDARDS
FILLING IN THE SPATIAL GAPS

- Developing indicators based on remote sensed information in conjunction with in-situ data and citizen science measurements
  - Water temperature
  - Nutrients
  - Soil moisture
  - Sediments
  - Best management practices
- Multivariate statistics
- Crowd sourced citizen science driven field measurements
  - Temperature
  - Water level
  - Spectroscopy ?