Session G3: Continuous Real-time Monitoring: QA from Start to Finish

Room B117-119
3:30 – 5:00 pm

0294
G3-1

"… and When That Doesn't Work …" Real-Life in Real-Time Monitoring

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The use of sensors to continuously collect and store water-quality data is a relatively recent development in freshwater ecosystem studies. The development of standard operating procedures (SOPs) for many of these technologies and applications has not kept pace.

Many practioners have learned valuable lessons by trial and error. This presentation will present photos/slides of monitoring sites, instruments, and data where implemented practices and procedures have not been fully effective for a variety of reasons. The processes and innovations will discussed for the continuous water quality monitoring network on the Lower Rio Grande from Falcon Dam to Harlingen, Texas.

0540
G3-2

From Quality Assurance to Data Elements: Making the Connections for Sensors

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Data quality management for field measurements begins with a series of actions, done by the field operators, to assure and document the quality of data collected by water quality sensors. A matrix of recommended actions to Affect, Check, Record, and Report (ACRR) the quality of measurement data was modified and adopted in 2010 by the Aquatic Sensors Workgroup (ASW, a workgroup of the Methods and Data Comparability Board affiliated with the National Water Quality Monitoring Council). The ACRR matrix lists the minimum actions needed to collect data of known quality and integrity from attended and unattended sensors. Known data quality requires documentation, and documentation requires placeholders (i.e., an array of "data elements"), for records of all relevant Result descriptors including the outcomes of quality checks. The records are essential for the basic data verification and validation functions and for evaluation of uncertainty. Quality-related information has to be managed in a way that links it to the Results it supports, and this requires placeholders for linking and tracking entities (e.g., Instrument ID). A comprehensive list of data elements for sensors, that covers the suite of data quality management functions, has been adopted by the ASW and will be introduced in this paper. This list is designed for use at the Project (original data collector) level. Once the monitoring Results have been validated and qualified, they can be shared with others outside the Project via a central database or a data exchange network. Data sharing requires only a sub-set of data elements that provide sufficient information on the "who, what, when, where, why, and how" of the data. This sub-set of "shared" data elements must also contain information on the data quality and what the data represent in the environment. The presentation will follow the logical flow from the ACRR matrix, through the major data management functions, to the 7 groups of data elements with a focus on water quality sensors.

0001
G3-3

Estimating Missing Water Quality Data in Time Series

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RIWA, the Association of water works using Rhine water as their drinking water source, operates a water quality monitoring network to identify (undesired) changes in quality and to test compliance with legal standards and threshold values set by a consortium of water works along the Rhine, Danube and Meuse rivers. The results are published annually and are used to underpin requirements to water authorities for improvement.

The time series of water quality data are sometimes interrupted so that it is more difficult to obtain statistically sound statements. This can be due to a multitude of causes, such as changes in analytical methodology, switching between laboratories doing the analyses, miscommunication, or (temporary) financial cuts.

X-ray contrast agents constitute an important set of variables in the network. The time series of these substances were interrupted for various reasons. Several attempts were made to estimate missing values in order to still be able to detect trends. Among these attempts were a Box-Jenkins time series model using the X-ray contrast agent data from an upstream site; a linear interpolation between an upstream and a downstream site; and a commercially available neural network software package. First, existing time series of chloride data were used to determine the effectiveness, by deleting parts of the series and “reconstituting” the series for each technique and comparing the results with the original series. Chloride was chosen because of the large datasets available and a conservative behaviour similar to that of the X-ray agents. Based on the results the artificial neural network was selected as the best alternative. The accuracy of the estimated missing values with this network was shown to be acceptable and it also has a built-in flexibility to model both linear and non-linear relationships.

Missing values in the data series of X-ray contrast agents measured at three different sampling locations were estimated with reasonable precision, using this network. Once completing these data series of X-ray contrast agents, the standard RIWA trend analysis could be applied. The estimation of the missing values prevented in this way a considerable loss of capital and information.

0247
G3-4

USGS Protocols for the Operation of Continuous Water-Quality Monitors

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Many agencies and organizations monitor water quality continuously in freshwater and marine environments to better understand the interrelations between stream hydrology and water quality. Compared to manual sampling, continuous monitoring can be a cost-effective approach to evaluate trends and can provide a more comprehensive comparison to water-quality criteria. However, limited resources are available to provide consistent protocols for quality assurance, quality control, and data management.

Continuous water-quality sensors are subject to errors due to fouling and drift. Most current-generation units incorporate wipers that help to reduce fouling from biological or sediment sources, and the sensors are more robust and less sensitive to sensor drift than in the past. However, consistent protocols for the operation of water-quality sondes are required to assure the quality of data recorded.

One set of protocols is the “Guidelines and standard procedures for continuous water-quality monitors: station operation, record computation, and data reporting” (Wagner and other, 2006), which is a quality-assurance plan for the operation of continuous water-quality sensors that describes five major quality-assurance concepts: (1) a standard protocol for servicing sensors, (2) calibration criteria, (3) data-correction criteria, (4) maximum allowable limits, and (5) a rating of quality.

The standard protocol for servicing sensors describes operation and maintenance under stable environmental conditions. Information to adapt the protocol to estuarine environments, changing environmental conditions, or for ground-water monitoring is provided as well. Records computation procedures to generate quality-assured data are described and include application of data corrections and final data evaluation. Final data evaluation includes application of a rating of data quality from excellent to poor for each measured field parameter.

Wagner, R.J., Boulger, R.W., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors: sites selection, field operation, calibration, record computation, and reporting: US Geological Survey Techniques and Methods Book1, Chapter D3, 51 p. plus attachments.