WaterML2.0: Enabling water information exchange

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Our ability to share and understand water information from various sources is currently limited by the use of incompatible information management and publication technologies. Water management bodies, hydropower companies, meteorologists and other interested stakeholders all monitor water resources and store their data using a wide array of technologies.

Standards are multi-party agreements that provide a common ground on which people can share information by minimising ambiguity and sharing definitions for domain concepts. They are most effective when surrounded by an active community who, along with taking part in defining such concepts, develop supporting tools that allow for easy transmission and interpretation of data sets.

Currently there are no internationally agreed upon standards for encoding water observation data, although there are some national standards in use, such as Water ML1.1. The Hydrology Domain Working Group (HDWG) was set up by the Open Geospatial Consortium (OGC) and the World Meteorological Organisation (WMO) to develop an international standard for the exchange of water information. It has produced a report[2] outlining the harmonisation of significant existing standards in water and is now developing WaterML2.0 as a new international standard.

WaterML2.0 is based on the ISO and OGC standard Observations and Measurements (O&M). O&M relates an observation of a property of a feature of interest, measured by a process and producing a result. For example, measuring the temperature of a lake using a thermometer as 22 deg. Celsius. O&M can be broadly applied in many scientific domains and as a result its default implementation is very general. WaterML2.0 makes a specific version of O&M for the hydrology domain. Being more specific allows hydrologists to use concepts natural to their field and facilitates consistent mapping of hydrology data into a format for exchange.

Features in O&M are, consistent with the ISO general feature model, meant for real world entities such as rivers, lakes and catchments. It is common, however, not to measure the properties of features directly, but instead to sample the features and measure the property of the sample. For example the thermometer is not measuring the temperature of the entire lake but just the sample around the thermometer. In turn this result can be used to approximate the value of the property for the whole feature. O&M part 2 provides the sampling feature concept which does just that. In WaterML2.0 the sampling feature is specialised further to a Water Monitoring Point. Even complex observations such as thermistor strings can be reduced to observations at a point with each observation having a different procedure giving its offset along the string.

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[2] http://portal.opengeospatial.org/files/?artifact_id=39090

In general O&M the property being observed at the Water Monitoring Point may be complex, i.e. composed of multiple properties. For example, observing wind velocity could be broken into speed and direction. To simplify the observations in WaterML2.0 only single, simple properties are allowed. So one observation will measure wind speed and a separate observation will measure direction. They can be represented as a pair in the client and the server, but keeping them separate in an exchange format creates a simpler and more versatile format. The relationship is not lost in WaterML2.0. They are related because they related to the same feature. They can also be related explicitly by creating collections of observations.

Encoding the definition of the observation process can be complex. OGC developed SensorML for this purpose. To keep WaterML2.0 lightweight this was not used, however some process information can be packaged with the data. For example, often hydrological data are derived data, such as daily mean flows. WaterML2.0 allows representation of such data, while keeping reference to the original source of measurement. It also allows for provision of arbitrary parameters. For example, in the case of a complex sensor like a thermistor string it can be used to define the offset and count of the thermistor in the string.

This initial version of WaterML2.0 is built around timeseries based readings from in-situ sensors. The WaterML2.0 result contains significant metadata for the correct interpretation of the data as a series and the ability to add qualifiers or flags on a per point basis. Cumulative, isochronic (constant time step) and irregular time series are catered for. The notion of data type is also supported. A data type describes the relationship between points in a series. With this information the points can be correctly interpolated. For example, a data type of 'preceding mean' specifies that the value is the mean of the preceding interval. Currently only numeric values are allowed.

WaterML2.0 has been endorsed by the HDWG. A time for public comment will commence soon and your input is welcome. Participation is also encouraged in Interoperability Experiments (IE). To date WaterML2.0 has been tested in sharing ground water and surface water data. An IE in hydrological forecasting using WaterML2.0 data will commence soon. The formal process of WaterML2.0 becoming an OGC standard is already underway. The HDWG is aiming for this process to complete in late 2011.

Gavin Walker and Peter Taylor are part of the water information research and development alliance between CSIRO's Water for a Healthy Country Flagship and the Australian Bureau of Meteorology.