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WaterML2.0 - part 2: Ratings, Gaugings and Sections Discussion Paper

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Contents

i. Abstract

This document describes an information model for exchanging *rating tables, or rating curves,* that are used for the conversion of related hydrological phenomenon. It also describes a model describing the observations that are used to develop such relationships, often referred to as *gauging observations*.

The information model is proposed as a second part of the WaterML2.0 suite of standards, building on part 1 that addresses the exchange of time series[1].

ii. Keywords

The following are keywords to be used by search engines and document catalogues.

ogcdoc, waterml, ratings, gaugings, o&m

iii. Preface

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

iv. Submitting organizations

The following organizations submitted this Document to the Open Geospatial Consortium:

- CSIRO
- Australian Bureau of Meteorology
- Centre for Ecology and Hydrology, UK
- KISTERS
- San Diego Supercomputer Centre, University of California.
- USGS

[1] www.opengeospatial.org/standards/waterml

v. Submitters

All questions regarding this submission should be directed to the editor or the submitters:

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1. Scope

This document describes a preliminary information model to describe hydrological ratings and gaugings observations. Currently the information model does not cover river cross sections or related survey information -- this will be tackled in the continuing work. This document describes the UML information model only; the XML Schema is not covered at this stage**. The intention of this discussion paper to elicit feedback from the community on the current model and direction of work**.

This work is being conducted by members of the joint WMO/OGC Hydrology Domain Working Group.

2. References

The following normative documents contain provisions that, through reference in this text, constitute provisions of this document. For dated references, subsequent

amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

- ISO 19103:2005 – Conceptual Schema Language
- Abstract Specification Topic 20 – Observations and Measurements (aka ISO 19156:2011)
- OGC Abstract Specification Topic 11 – Geographic information — Metadata (aka ISO 19115:2003)07-036 Geography Markup Language (aka ISO 19136:2007)
- OGC SWE Common Data Model Encoding Standard v2.0 OGC Document 08-094r1 http://www.opengis.net/doc/IS/SWECommon/2.0
- OGC WaterML2.0 part 1 - time series, www.opengeospatial.org/standards/waterml, 10-126r3.

3. Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r8], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this standard. *Section 10 is an informal documentation of requirements and does **not** conform to use of ‘shall’*. This reflects the discussion paper nature of this document.

For the purposes of this document, the following additional terms and definitions apply.

3.1 Conversion

A conversion defines the relationship between two physical properties using an equation, x-y point table or other form. E.g. a stage-discharge conversion defined by a **rating table**.

3.2 Conversion group

A group of applicable periods that define conversions relating to a specific monitoring point and property combination (the parameter being converted from and the parameter being converted to).

3.3 Conversion period

A period of time for which a particular conversion is applied. Only one conversion is applicable at any one time.

3.4 Gauging observation/gauging/conversion observation

An observation performed to measure two related variables with the aim of defining their relationship using a rating curve and/or table.

3.5 Measurement

Set of operations having the object of determining the **value** of a quantity

[ISO/TS 19101-2:2008, definition 4.20]

3.6 Observation

Act of observing a **property**

NOTE The goal of an observation may be to **measure** or otherwise determine the **value** of a property

[ISO/DIS 19156:2010]

3.7 Observation result

Estimate of the **value** of a **property** determined through a known procedure

[ISO/DIS 19156:2010]

3.8 Procedure

Method, algorithm, instrument, sensor, or system of these which may be used in making an observation.

[OGC 10-004r3/ISO 19156]

3.9 Rating table/curve

Any table showing the relation between two mutually dependent quantities or variables over a given range of magnitude, e.g., a table showing the relationship between the stage in a reservoir and its volume. (Source: http://www.bom.gov.au/water/awid/index.shtml)

3.8 Sampling feature

Feature, such as a station, transect, section or specimen, which is involved in making **observations** concerning a domain feature

NOTE A sampling feature is purely an artefact of the observational strategy, and has no significance independent of the observational campaign.

[ISO/DIS 19156:2010]

4. Background

WaterML2.0 is an initiative within the Hydrology Domain Working Group (HydroDWG)

to address standards development and interoperability of hydrological information systems at an international level. The first part of WaterML2.0 (www.opengeospatial.org/standards/waterml) focused on a standard information model, and XML encoding, for time series of hydrological observations. The scope was defined by priority areas of members of the HydroDWG and through identification of common requirements. The development involved a harmonisation process whereby existing formats were compared and contrasted with an aim of capturing the key elements for time series data exchange. Early versions of the standard were tested through a number of OGC Interoperability Experiments, each resting against a different set of use cases.

WaterML2.0 part 2 focuses on another key aspect of hydrological data: rating tables/curves, gauging observations and river cross-sections. These are part of almost all surface water monitoring programs and are used in daily operations, including reporting, analysis, modeling and forecasting. This type of data is becoming increasingly important to exchange and share outside the scope of single organisations, as the awareness and desire to analyse this type of data grows.

Key concepts

Rating curves – which may also represented as tables – are mathematical relationships allowing conversion from a physical phenomena to an estimate of a related phenomena; the captured relationship represents an approximation of a physical relationship. The most commonly employed rating curves in hydrology are stage-discharge rating curves, which allow for estimates of the volumetric flow rate of water at a point in a river. Curves are developed from multiple observations – often termed gaugings – of stage and flow at a particular measuring location. The relationship is a complex one and many techniques exist for building up rating curves; from equipment used in the observation process to the methods of computation and conversion. The subtleties are not covered here, but the approaches used will have a varying degree of influence on the requirements for representation of a curve and/or table. The most common method for determining an estimated discharge measurement is the velocity-area method, roughly described in the following steps:

- The velocity of water is measured in different segments of the river cross-section.
- The volume for each segment is calculated based on the velocity using a selected method (arithmetical, graphical etc.)
- Summation of the segments gives an estimate of total discharge.

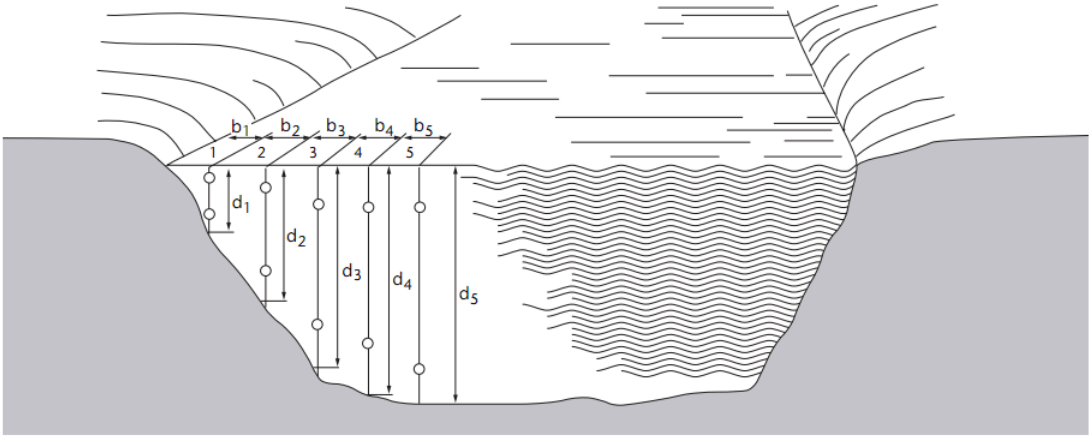


Figure 1 - View of a stream cross-section showing the location of points of observation[1]

The method used to determine the velocity at each point varies – more traditional techniques involve the use of a current meter attached to a propeller that is lowered into the river, sometimes from a boat or directly by an operator standing in the river.

The use of acoustic methods, such those provided by Doppler instruments, are increasing in use due to their practicality and availability of commercial instruments. For example, an Acoustic Doppler Current Profiler (ADCP) is attached to a boat that makes use of the Doppler effect to measure velocity of suspended particles in the river. It will simultaneously measure the depth and path of the vessel to calculate discharge. Multiple transects are taken by the boat to provide a more accurate measurement.

Once a rating curve has been established it is an estimate of the stage-discharge relationship at a given place and time. The relationship is based on time discrete observations that represent the flow through the river cross-section in varying conditions. For natural channel controls, the cross-section of the river is often not static due to factors such as erosion, changes in vegetation, sediment build up, among others. Man-made control structures generally are not affected to the same extent by such physical process, but may still undergo change, or even removal. Thus rating curves often have an associated period of applicability: they need to be continually evolved as conditions change. Most river operations will regularly perform gaugings to keep rating relationships up to date.

The exchange of rating curves may be done through definition of a table that represents the stage-discharge relationship or by definition of an (often polynomial) equation representing a fitted curve. **Error! Reference source not found.** shows an example plot of a rating curve (on a log-log scale) with the individual gauging points and rating period of application. WMO recommends a curve should "…include at least 12 to 15 measurements, all made during the period of analysis" and these should be "…well distributed over the range of gauge heights experienced."

[1] Extracted from WMO Guide to Hydrological Practices, Volume I.

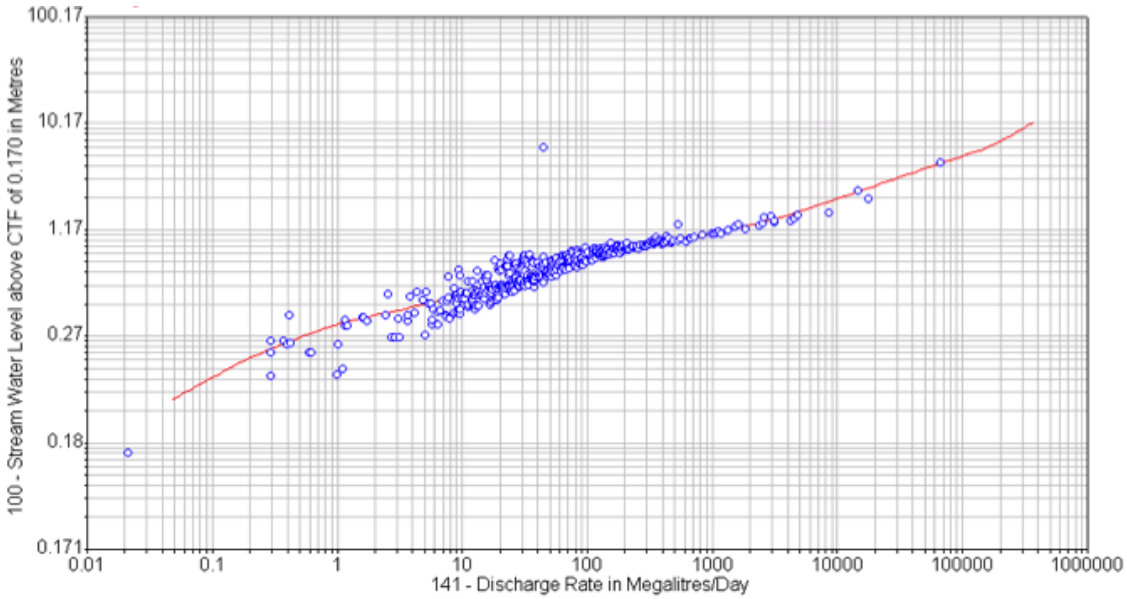


Figure 2 - Example stage-discharge rating relationship, showing gauging observations[2]

5. Use cases/scenarios

Sharing of rating curves is required in multiple scenarios, generally stemming from the need to perform the calculation of the derived phenomenon or to analyse the derived data with a view to understanding inherent uncertainty or quality. The following use cases were used in the requirements analysis process and produced a set of requirements that are described later in this document.

Data scrutiny

A primary use case for exposing detailed descriptions of rating tables is for closer scrutiny of derived data sets. A number of regularly used hydrological time-series -- the most obvious being river discharge/flow -- are derived using techniques that are approximations for relationships between other more readily measurable phenomenon. It is becoming increasingly important for these data to be treated carefully due to the inherent assumptions made in the transformation process[1].

Four scenarios were used when analyzing requirements from this perspective:

1. Uncertainty research.

2. Geomorphic process, cross sections.

3. Engineering design, e.g. designing a flood barrier.

[2] Graph extracted from http://www.water.nsw.gov.au/. Identifiers and site details removed.
[1] Beven, K., & Westerberg, I. (2011). On red herrings and real herrings: disinformation and information in hydrological inference. Hydro- logical Processes, 25(10), 1676-1680.

4. Analysis and assessment of input data for hydrological models.

Exchange of specific rating table

It is often desirable to have instant access to a specific rating table relationship for a specific purpose. Some indicative examples include:

1. Time sensitive (floods, events, emergencies)

2. Inundation modeling (reversing out the independent variable (e.g. stage))

3. A site visit or comparing a gauging point against the curve

Exchange of full rating history

Often a centralised repository or reporting agency requires access to a full history of rating tables to run derived calculations for specific sites at any point in time. This requires a full history of rating tables as they have evolved through time. This would often exclude development versions of rating tables that have not been approved for use or release.

Suspended sediment and load calculations

Sediment-transport relationships (for calculating concentration, loads etc.) are used in numerous scenarios requiring an understanding of expected sediment build up or effects on the general environment. These relationships are often required by hydraulic or civil engineers for particular analysis or case studies.

Transfer between disparate information systems

This use case covers exchange between systems that do not have a common information model/schema for representation of rating tables. While this is a generic use case that may occur within the above scenarios, it is an important one for operation and interoperability of distributed information systems.

Research services

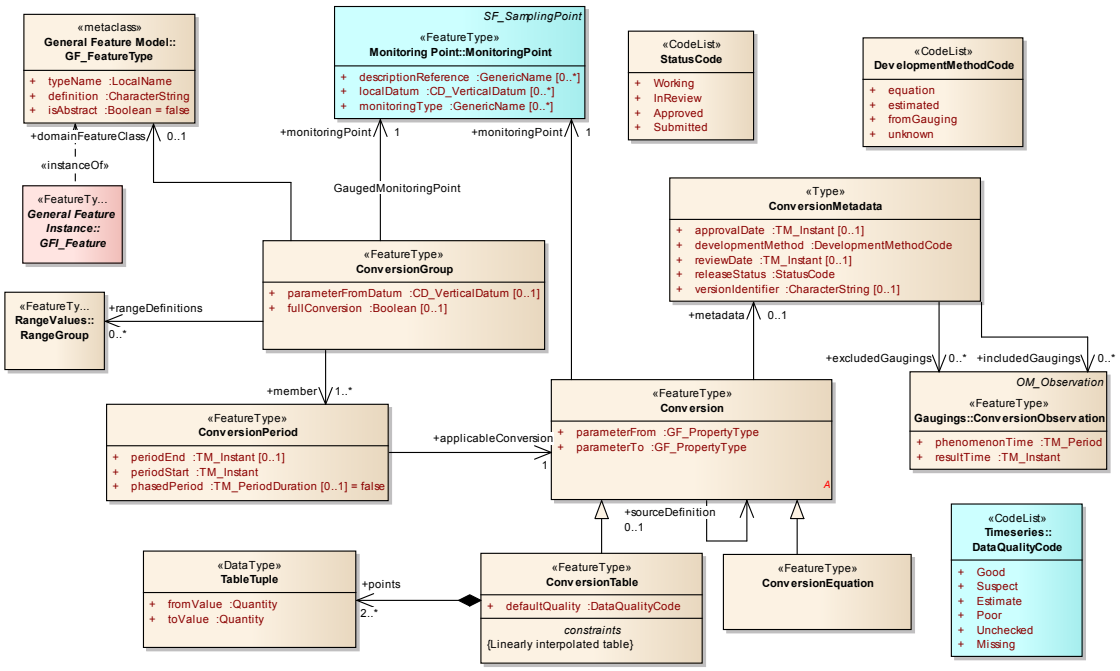
General hydrological studies benefit from open access to hydrological data that may be used in educational scenarios, such as those provided by CUAHSI. Rating tables and gauging observations are fundamental concepts within hydrological operations and having access to real world data in common formats supports learning these base concepts.

6. Model description

The following section provides details of the model developed thus far. This model is under development, but the core concepts and scope have largely been agreed on by members of the working group.

The model section is followed by a list of requirements developed by the working group, based on analysis of the use cases and exchange scenarios.

7. Conversions overview



General overview

Conversions are defined by the parameter (phenomenon - GF_PropertyType) they convert from and to, as well as their associated monitoring point. A conversion may be represented using a table or an equation, however a ConversionTable is the mandatory exchange target (this constraint is not shown in the model).

A Conversion contains metadata relating to its current status, review lifecycle etc. A conversion may be related to its source definition (e.g. an expanded table may be related back to its original equation form), however the equations themselves are not defined in a machine readable form (a formal equation model won't be developed).

A ConversionTable is composed of one or more tuples that define the independent and dependent variable values as quantities. The table is an expanded, linearly interpolated table. The granularity of the points is defined by the exporting system, but should be sufficient to re-use the table.

The ability to link from the conversion to the gaugings that were used (or excluded) in development is available as associations from the conversion metadata type.

A ConversionGroup describes one or more ConversionPeriods that also relate to a particular monitoring point and parameter combination. The ConversionGroup thus captures the logical grouping of conversion and applicable periods as they have been captured through time.

Conversion

A Conversion defines the relationship between two parameters: a parameter being converted from (the independent variable) and the parameter being converted to (the dependent variable). A conversion applies to a specific monitoring point.

Often conversions are worked on in-line with internal data management policies. This work will generally involve edits to a conversion, sometimes generating different versions of a conversion for the same applicable period. In the US, these are sometimes represented as shifts to a particular version of a conversion. In this model, by convention, the most recent version of the conversion is the only version being communicated. If shifts are in use, the shift that is the most up to date should be applied to the conversion and the result is exchanged.

sourceDefinition (0..1)

This is an extension point to enable propriety systems to refer to an encoding of their systems definition of the conversion.

This captures the requirement of RGS-07 to enable referring to original definition of the conversion, e.g. equation or logarithmic interpolated points table. The referenced information will be defined by individual usage.

monitoringPoint (1)

Association of the conversion with a 'WaterML 2.0: Part 1- Timeseries' monitoring point.

applicableConversion (1)

The applicable conversion for this period.

metadata (0..1)

Association of a conversion with the Metadata of the conversion.

parameterFrom (1 ... 1)

The parameter being converted from. E.g. river level/stage.

parameterTo (1 ... 1)

The parameter being converted to (i.e. target parameter of the conversion). E.g. stream flow/discharge.

ConversionEquation

A conversion may be defined by an equation. The scope of the initial conversion development activity did not include the specification of equations. It is recognised that there is an interoperability need to include the use of a common method of encoding

equations. It is modeled here as a requirement for future extensibility.
The exact form of the equation is not defined here, but identified as a future option for encodings.

ConversionGroup

A conversion group defines a logical grouping of conversion periods to capture the changing conversion relationship through time. This group may represent the full conversions for these parameters available at a site (see fullConversion attribute).
The Conversion's direct connection to the monitoring point supports transfer of a single conversion.

member (1..*)

Captures the conversion period members of the group. Each period defines a period of application that makes up the group.

rangeDefinitions (0..*)

The available range value definitions for this conversion group (combination of parameterFrom/To and monitoring point).

domainFeatureClass (0..1)

The type of domain feature that this conversion group relates to. For example: river reach, reservoir etc. See HY Features models for examples of relevant feature types. This can be determined through the monitoringPoint relationship to the domain feature, but it is sometimes important to have the domain type available with the conversion definition.

monitoringPoint (1)

The monitoring point that was used as the gauging station.

parameterFromDatum (0 ... 1)

The vertical datum that is associated with the independent (parameter from) phenomenon.

fullConversion (0 ... 1)

Defines whether this group of conversion contains all the available conversions for a site-paramTo-paramFrom combination. This would be false, for example, if the group contains only the latest conversions.

ConversionMetadata

Describes metadata relating to the conversion. Generally this related to conversion development processes (review, development method etc.).

metadata (0..1)

Association of a conversion with the Metadata of the conversion.

excludedGaugings (0..*)

References to gaugings that were excluded from this conversion in its development. Association properties (e.g. arcrole if an XML target) may be used to specify the reason for exclusion.

includedGaugings (0..*)

References to gaugings that were used in development of this conversion. Association properties (e.g. arcrole if an XML target) may be used to specify the reason for exclusion.

approvalDate (0 ... 1)

If the conversion has been approved this represents the date the conversion was approved for use, this is not related to the conversion period start date.

developmentMethod (1 ... 1)

A code that gives an indication of the method used to develop the conversion relationship. See DevelopmentMethodCode.

reviewDate (0 ... 1)

Date of the last review of the conversion where the conversion was assess for accuracy in relation to input data or observations such as gaugings.

releaseStatus (1 ... 1)

A code indicated the status of the conversion relating to its development lifecycle.

versionIdentifier (0 ... 1)

A version identifier for the conversion, if available. Only one conversionTable for a conversion period is published. The version identifier may be used to indicate the revision sequence number, identifier or text describing the current version.

ConversionPeriod

A conversion period defines the time period in which a particular conversion relationship should be used. Conversion periods may re-use conversions for different periods (e.g. the physical relationship is changed for a period of time due to some installation and reverts to the previous conversion once this is removed).

applicableConversion (1)

The applicable conversion for this period.

member (1..*)

Captures the conversion period members of the group. Each period defines a period of application that makes up the group.

periodEnd (0 ... 1)

The end of the conversion period. This is optional and is used to define a gap between conversion periods or a period of validity for the current conversion table. Normal usage would involve a succession of conversion periods defined by only periodStart dates.

periodStart (1 ... 1)

The start of the conversion period.

phasedPeriod (0 ... 1)

A change in applicable conversion table is controlled by adding records to the conversion period. The conversion period declares the table that is active and the date and time from which it is active. This means that there is an instantaneous switch from one conversion table to the next.

A transition is a method to define the change between two different conversion tables over a period of time rather than instantaneously. Transitions are useful when the underlying physical change is a gradual one, for example with the accumulation of algae, ice or weeds; scouring and aggregation of river bed.

The phasedPeriod property specifies the period over which the conversion should be phased from the preceding table to the current table. The phase period begins at conversionStart and ends after the duration of the phasedPeriod. There is a linear progression from the preceding table to the current table during the phasedPeriod.

A phased change more closely reflects the underlying change in physical relationship.

ConversionTable

A conversion table is the primary target for exchange of conversion relationships. It encodes the relationship of the parameter being converted from (independent variable) to the parameter being converted to through a table of tuples. This table shall be of sufficient resolution to allow linear interpolation between points.

points (2..*)

The points that make up the conversion table.

defaultQuality (1 ... 1)

Defines the default quality code for the whole table. Individual quality assertions override the default value.

DevelopmentMethodCode

A code indicating the way the conversion was developed.

equation (1 ... 1)

The conversion was developed using a standard equation (e.g. from a known control structure).

estimated (1 ... 1)

The relationship has been estimated using modeling, mass balance or other quantifiable techniques

fromGauging (1 ... 1)

The conversion was developed using regular gaugings.

unknown (1 ... 1)

Unknown development method.

StatusCode

A proposed list of status codes to indicate where the conversion is in its development lifecycle.

Working (1 ... 1)

The conversion relationship is the working version. This is the currently active conversion.

InReview (1 ... 1)

The conversion is under review.

Approved (1 ... 1)

The conversion has been approved for use.

Submitted (1 ... 1)

The conversion has been submitted but has not been assessed.

TableTuple

A tuple represents the relationship between two values: a value of the parameter being converted from (the independent variable) and the value of parameter being converted to

(the dependent variable).

points (2..*)

The points that make up the conversion table.

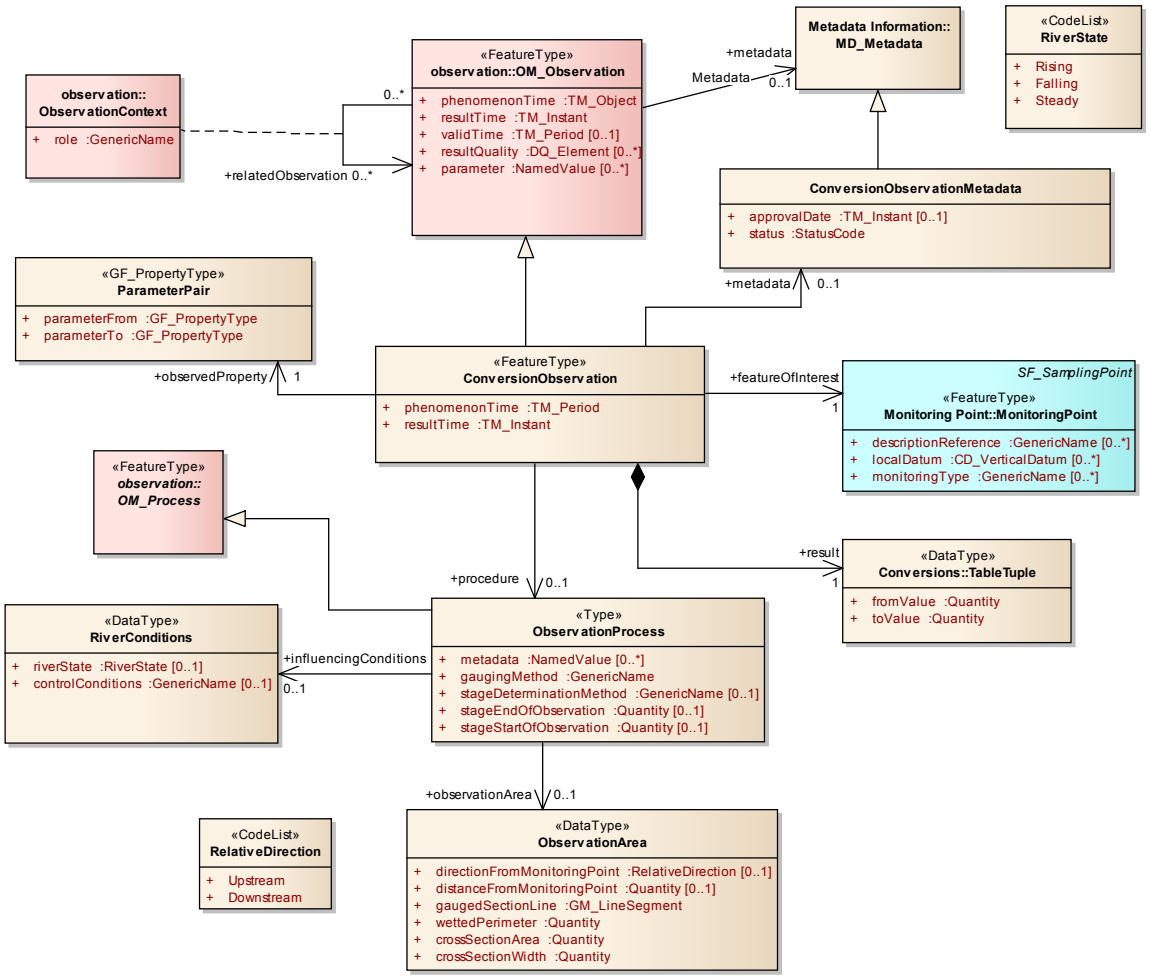
fromValue (1 ... 1)

Individual value of the parameter being converted from.

toValue (1 ... 1)

Individual value of the parameter being converted to.

8. Gaugings overview



General overview

Conversion observations, sometimes called gaugings, are the observations that are made to record the relationship between two parameters at a specific point in time, influenced by the environmental conditions. These observations are used to either build an empirical conversion relationship or to verify a theoretically produced relationship between the parameters.

These observations are performed using wide array of methods, procedures and types of hardware. The focus of this model is to capture the x-y value that results from (potentially many) observations that are made to estimate the relationship between two variables. For example, to understand the stage-discharge relationship at a gauging station, many observations are made at different x-y-z locations within a watercourse. These results are generally used to calculate an aggregate a single stage-discharge estimate for the section of the river.

ConversionObservation

Conversion observations are captured as a specialised type of the O&M concept of an Observation:

- The feature of interest relates to the location at which the gauging observation has taken place or the gauging station;
- The result is a measurement tuple that represents the value of the independent phenomenon (e.g. stage) and the dependent phenomenon (e.g. discharge).
- The observed property groups the two phenomena together into a parameter pair. The alternative is to model the gauging as two separate measurement observations, one each for the independent and dependent phenomena. It is common practice however to combine the two together as this is the normal interpretation when related to estimation of the conversion relationship.
- The process is captured with a type categorisation and extensible metadata properties. The variety of methods and metadata for gauging observations is extensive. Harmonisation of all the methods is not practical and would most likely rely on more fully standardised measurement methods.
- A metadata type captures common metadata relating to the observation, such as influencing environmental conditions, status of the observational data etc.

featureOfInterest (1)

The gauging station used for the gauging observation.

procedure (0..1)

The procedure used in making the observation. A specialised type is provided to detail important aspects of the observation procedure. There is huge diversity in the available methods for conversion observations; the key aspects are captured here to provide useful metadata for result interpretation.

observedProperty (1)

The observed property pair that is being observed and calculated. This will normally be an identifier that links to a vocabulary definition for the type of physical property being measured. The observed property is a tuple that captures the two properties that are being related.

metadata (0..1)

Metadata for the gauging observation.

result (1)

The result of the gauging observation. This is the calculated value of the derived value and the observed independent variable through the period of observation.

excludedGaugings (0..*)

References to gaugings that were excluded from this conversion in its development. Association properties (e.g. arcrole if an XML target) may be used to specify the reason for exclusion.

includedGaugings (0..*)

References to gaugings that were used in development of this conversion. Association properties (e.g. arcrole if an XML target) may be used to specify the reason for exclusion.

phenomenonTime (1 ... 1)

The phenomenonTime property (inherited from O&M) represents the start and finish time of the gauging measurement. They will be equal if a measurement was instantaneous.

resultTime (1 ... 1)

The resultTime (inherited from O&M) represents the time allocated to the observation result. This may be determined using an weighted time average across the period of observation for example.

ConversionObservationMetadata

Captures metadata relating to the gauging observation.

metadata (0..1)

Metadata for the gauging observation.

approvalDate (0 ... 1)

Date that the gauging observation was approved.

status (1 ... 1)

Captures the status of the gauging in terms of its use in conversion relationships.

ObservationArea

A type capturing the key spatial components of the observation.

observationArea (0..1)

This property captures metadata relating to the region and location of the observation process. This includes information relating to the cross section that was used in observation and relative location to the monitoring point.

directionFromMonitoringPoint (0 ... 1)

A relative direction from the monitoring point to the location the measurement was made.

distanceFromMonitoringPoint (0 ... 1)

The distance to the monitoring point from the measurement location.

gaugedSectionLine (1 ... 1)

The line (start coordinates, end coordinates) that describes the segment of the river that was measured.

wettedPerimeter (1 ... 1)

The perimeter of the cross-section that is in contact with water flow.

crossSectionArea (1 ... 1)

The area of the cross-section that is being measured.

crossSectionWidth (1 ... 1)

The width of the cross-section that is being measured.

ObservationProcess

A description of the procedure used to convert the independent and dependent observations into a gauging.

Implements requirements:
rgs-26 A ConversionObservation is a summary result of the gauging activity, it is not a detail of the measurements taken to determine the gauging result.

rgs-28 The rich suite of USGS site visit information is out of scope for this activity.

observationArea (0..1)

This property captures metadata relating to the region and location of the observation process. This includes information relating to the cross section that was used in observation and relative location to the monitoring point.

influencingConditions (0..1)

Captures conditions that influenced the measurement process during the period of observation.

procedure (0..1)

The procedure used in making the observation. A specialised type is provided to detail important aspects of the observation procedure. There is huge diversity in the available methods for conversion observations; the key aspects are captured here to provide useful metadata for result interpretation.

metadata (0 ... *)

A soft-typed property for metadata properties. This can hold name-value pairs for capturing metadata terms not defined explicitly in the process type.

Implements Requirements:

rgs-29 Rating type specialised metadata. Stream discharge RatingObservations have specific metadata that is of value and should be communicated. Other ratingObservations would not be required to contain this information

rgs-31 Rating type specialised metadata. A WQ sepecialsed type is in scope as a stretch gaol. External input would be required to determine the content

Provides the ability associated metadata attributes to the gauging process that have not been otherwise identified. These would include organization specific attributes, for example a specific environmental conditions flag.

gaugingMethod (1 ... 1)

Describes the type of the gauging method that was used using a controlled vocabulary. For example: area-velocity, ADCP, mechanical meter etc.

stageDeterminationMethod (0 ... 1)

Describes the type of the gauging method that was used using a controlled vocabulary. For example: area-velocity, ADCP, mechanical meter etc.

stageEndOfObservation (0 ... 1)

Observed stage at end of observation period.

stageStartOfObservation (0 ... 1)

Observed stage at start of observation period.

ParameterPair

The pair of parameters (independent/dependant) that the gauging process relates.

observedProperty (1)

The observed property pair that is being observed and calculated. This will normally be an identifier that links to a vocabulary definition for the type of physical property being measured. The observed property is a tuple that captures the two properties that are being related.

parameterFrom (1 ... 1)

The input parameter (phenomenon).

parameterTo (1 ... 1)

The output, or derived, parameter (phenomenon).

Quality

Encapsulates any qualitative statement from a simple code to more elaborate model. I.e. to be expanded.

RelativeDirection

Provides codes to describe the location of the gauging measurement relative to the monitoring point.

Upstream (1 ... 1)

The measurement was performed upstream of the monitoring point.

Downstream (1 ... 1)

The measurement was performed downstream of the monitoring point.

RiverConditions

Captures conditions affecting the measurement being taken, along with

influencingConditions (0..1)

Captures conditions that influenced the measurement process during the period of observation.

riverState (0 ... 1)

The state of the river while the gauging was taking place (e.g. was the river rising.). See also stageStart/EndOfObservation.

controlConditions (0 ... 1)

Conditions affecting the control: e.g. weed growth, ice etc.

RiverState

A controlled list for terms describing the river state during the period of observation.

Rising (1 ... 1)

The river/level of feature was rising during observation.

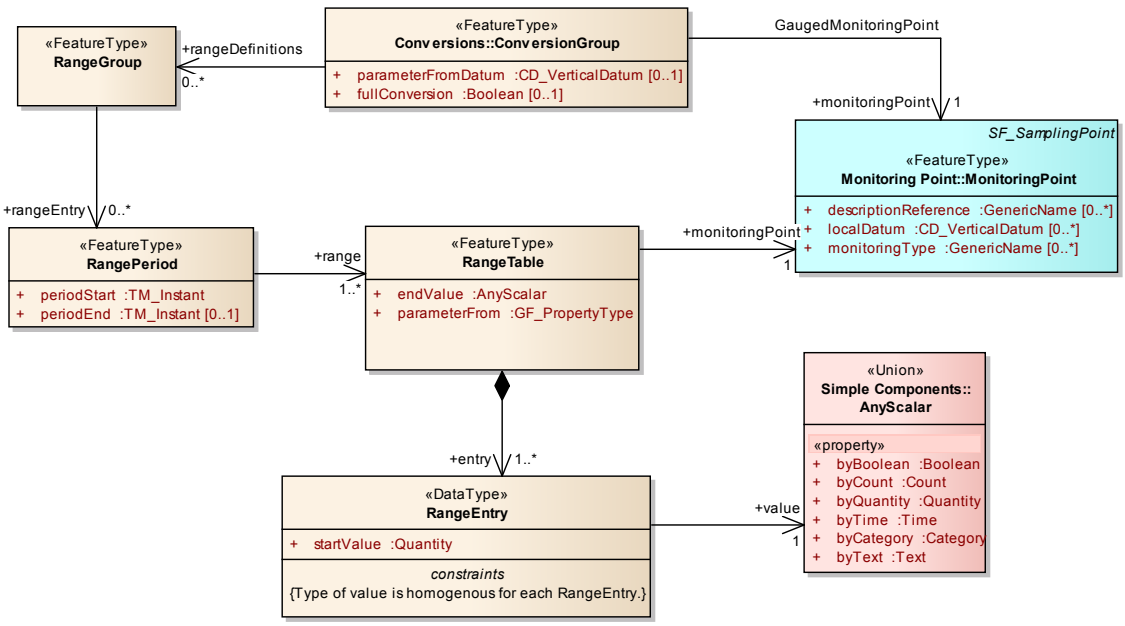
Falling (1 ... 1)

The river/level of feature was falling during observation.

Steady (1 ... 1)

The river/level of feature was steady during observation.

9. RangeValues overview



General overview

Range tables are a data structure that is similar to a conversion table except that the value applies across a broad input range and the content describes a state or condition that varies with the input range, rather than a conversion. Range tables may carry information that relates to, or adds value to, a conversion table. E.g. Information describing the rating construction method. A range table may carry information that is of value in it own right. E.g. Stage V. over bank flow condition (confined to channel, over bank flow).

RangeEntry

A single entry within the range values definition. A categorisation that defines the range of parameterFrom values that are associated with a range value. The parameterFrom start value is defied explicitly. The parameterFrom end value is defined by the lower of the next rangeCategory start value or the rangeDefinition endValue.

value (1)

The value of the range entry. This value holds until this next range entry start value.

entry (1..*)

An entry within the range table.

startValue (1 ... 1)

The value from which the range entry begins. Each entry holds until the next startValue,

or to the endValue if it is the last entry in the definition.

RangeGroup

A group of range tables that have a period of application.

rangeEntry (0..*)

A range group contains entries of logically related range values.

rangeDefinitions (0..*)

The available range value definitions for this conversion group (combination of parameterFrom/To and monitoring point).

RangePeriod

A range of application for range metadata. If the end time is not specified the range is valid up to the following period start, or open ended (valid to now).

range (1..*)

The range definition for this period of application.

rangeEntry (0..*)

A range group contains entries of logically related range values.

periodStart (1 ... 1)

The start of the applicable period.

periodEnd (0 ... 1)

The end of the range period. This is optional and is used to define a gap between range periods or a period of validity for the current range table. Normal usage would involve a succession of range periods defined by only periodStart dates.

RangeTable

A RangeDefinition specifies metadata that is associated with a range of a quantity (e.g. from 2.3 to 3.5). For Conversions, this will most often relate to the independent variable (e.g. metadata for stage between 2.3 and 3.5 meters.). Ranges are specified by the start value and hold until the next range entry. The upper end of applicability is specified by the endValue attribute.

monitoringPoint (1)

The monitoring point for which this range entry is defined.

entry (1..*)

An entry within the range table.

range (1..*)

The range definition for this period of application.

endValue (1 ... 1)

The value at which the range entries end. Only the final end value is specified -- each range point holds from its start value until the next value, or if it is the last entry to the endValue.

parameterFrom (1 ... 1)

The value at which the range entries end. Only the final end value is specified -- each range point holds from its start value until the next value, or if it is the last entry to the endValue.

10. Informal Requirements

This section provides a listing of the core requirements for the RGS model. These were developed through the working groups' workshops and teleconferences.

Requirement: rgs-1

Description: Generalised conversion relationships are implemented rather than Stage/Flow only relationships. This enable relationships between user specified parameters to be defined.

Requirement: rgs-10

Description: Ratings are keyed to a Site / Point / ParameterFrom / ParameterTo.

Requirement: rgs-11

Description: When defining stage as a parameter for a conversion, the stage datum must be supplied.

Requirement: rgs-12

Description: Scope decision : The ratings being communicated are the 'Active ratings'. The ratings that would be applied to determine ParameterTo value. It will have been shift corrected and will be the active rating at the time. Return should indicate the date and time for wich the data applied

Requirement: rgs-13

Description: The use of conversion transitions / phased change is in scope

Requirement: rgs-14

Description: The use of start dates for a conversions period is agreed.

Requirement: rgs-15

Description: The use of end dates for a conversions period is agreed. The end dates is purely used for describing a gap. Rating gap periods can be implemented by end dates a or a null rating.

Requirement: rgs-16

Description: Rating point quality codes will be implemented at the point level. A rating quality can be defaulted with overrides for each point. Rating quality can be applied to equations. Rating quality can be communicated via an input range.

Requirement: rgs-2

Description: The WML2 RGS implementation contains data used to complete the calculation of derived information. The definition of the process that would be employed to complete the transfer function / transformation is not currently in scope, my may be in scope at a later revision

Requirement: rgs-20

Description: Conversions can specify Y scale range validated range (within rating), extrapolated range, beyond extrapolation.

Requirement: rgs-21

Description: There is a need for defining an input range purpose. An input range purpose should be a controlled vocabulary, the semantic meaning of each input range purpose should be defined against the vocabulary. Input range contents may vary over time, so should be referenced by periods of applicability.

Requirement: rgs-22

Description: The format should enable the inclusion of metadata to enable the communication ratings approval and review process

Requirement: rgs-23

Description: The application of 3d ratings is a stretch gaol. As such it is out of scope until scope is reviewed

Requirement: rgs-24

Description: We supply conversion information that is able to be used in simple or complex conversion chains. Communication of information that defines the 'chain conversion process' or 'work flow' of simple or complex chain conversions in not in scope.

Requirement: rgs-25

Description: Specific methods for the communication of uncertainty information are not currently agreed across the domain. This is an area of current domain development. The standard should be sufficiently extensible to enable incorporation when a direction is available.

Requirement: rgs-26

Description: A RatingObservation is a summary result of the gauging activity, it is not a detail of the measurements taken to determine the gauging result.

Requirement: rgs-27

Description: RatingObservations need to be connected to the rating for which they apply. This may be by direct, linked or other methods

Requirement: rgs-28

Description: The rich suite of USGS site visit information is out of scope for this activity

Requirement: rgs-29

Description: Rating type specialised metadata. Stream discharge RatingObservations have specific metadata that is of value and should be communicated. Other ratingObservations would not be required to contain this information.

Requirement: rgs-3

Description: Communcating the gaugings used in the creation of a rating is in scope. The gaugings if interest are:

- Gaugings used that were taken in the period of application of the rating
- Gaugings not used that were taken in the period of application period of the rating
- Gaugings used that we taken outside the application period of the rating. - e.g. high flow rating

Requirement: rgs-30

Description: RatingObservations may be used by one or many ratings.

Requirement: rgs-31

Description: Rating type specialised metadata. A WQ sepecialsed type is in scope as a stretch gaol. External input would be required to determine the content

Requirement: rgs-33

Description: A RatingObservation contains a definition of From and To parameters. The observations is not limited to stream discharge observations.

Requirement: rgs-34

Description: RatingObservations must be able to be delivered seperate from ratings. Rating observation may optionally be delivered inline with rating details

Requirement: rgs-36

Description: The conversion application period list may refer to a conversion table more than once. e.g. a conversion table is reused

Requirement: rgs-37

Description: A range value may refer to to a specific value, rather than a range. An example is references to flood extent polygons, the flood extent relates to a specific Y scale value and is not valid for a ranged of Y values (the range is vary narrow).

- Range Start value may equal range End Value

Requirement: rgs-4

Description: The inclusion of user specified user information that varies across the Y scale of a conversion is in scope. This would be used to give further information for the conversion. e.g. Control/Chanel/OverBankFlow Assessment of other sensor application range

Requirement: rgs-5

Description: Ratings should always have a point table supplied that is expanded at a sufficient Y scale resolution to enable linear interpolation between the supplied points. The creator of the data file will choose the export resolution such that linear interpolation is appropriate.

Requirement: rgs-6

Description: Ratings may have the equation that is the source system definition of the rating. This may be supplied using rgs-4.

Requirement: rgs-7

Description: A point rating table may have additional information the enables the source system to describe how it stored the table.

Requirement: rgs-8

Description: The implementation of loop rating curves is out of scope. Methods of implementation are possible, however the practical uptake of loop ratings means the topic is very much an edge case. It is understood that issues of uncertainty outstrip the accuracy issues that loop ratings address. Technology has provided other solutions through the use of velocity index tables and velocity sensing hardware.

Requirement: rgs-9

Description: Reverse conversions are not supported implicitly by either point or equations conversions. Reverse conversions can be defined explicitly.

11.References

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