Introduction to GWML 2 standard

Eric Boisvert – Geological Survey of Canada
Natural Resource Canada
Groundwater Markup Language 2
OGC WaterML 2: Part 4 - GroundWaterML 2 (GWML2) 2.2.1 OGC 16-032r3

Boyan Brodaric (GSC), Eric Boisvert (GSC), Francois Létourneau (GSC), Jessica Lucido (USGS), Bruce Simons (CSIRO), Peter Dahlhaus (FedUni), Mickaël Beaufils (BRGM), Sylvain Grellet (BRGM), Laurence Chery (BRGM), Alexander Kmoch (U Salzburg)

• Geological Survey of Canada (GSC), Canada
• U.S. Geological Survey (USGS), United States of America
• Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia
• Bureau of Meteorology (BOM), Australia
• Federation University Australia (FedUni), Australia
• Bureau de Recherches Géologiques et Minières (BRGM), France
• Salzburg University (U Salzburg), Austria
HydroDWG

Hydrology Domain Working Group (HydroDWG)

- Tony Boston (ANU, Australia)
- Silvano Pecora (ARPA, Italy)
- David Blodgett (US Geological Survey, USA)

- OGC ® WaterML 2.0 : Part 1 – Timeseries 2.0.1
- OGC ® WaterML 2.0 : Part 2 – Rating, Gauging and Sections 1.0
- OGC ® WaterML 2.0 : Part 3 – Surface Hydrology Feature (HY_Feature) 1.0
- OGC ® WaterML 2.0 : Part 4 – GroundwaterML 2.2.1
- OGC ® WaterML 2.0 : Part 5 – Water Quality
Background

• GWML1: a GML application schema for groundwater data developed at Natural Resources Canada

• GWIE1: an interoperability experiment within the OGC HydroDWG

• GWIE2: a second interoperability experiment within the OGC HydroDWG, tested a precursor of GroundWaterML2 (GWML2, version 2.1)

• INSPIRE Data Specification on Geology — hydrogeology package: a conceptual model and GML application schema for hydrogeology

• BDLISA: the French Water Information System information models for water wells and hydrogeological features
Represents things that are important for hydrogeology
GWML feature types

• Hydrogeological units
  • Geological container, composition

• Voids
  • The empty spaces in the geological container

• Fluid bodies
  • The fluid hosted by the spaces, its nature (composition, shape)

• Fluid flow
  • Movement of that fluid, recharge, discharge

• Wells *
  • Anthropological features, borehole, casing, screen
  (More O&M than GWML)
Hydrogeological units, fluid bodies

Fig. 3 GWML2 hydrological unit, void, fluid body, monitoring and management entities
Hydrogeological Units are Geological Units

Therefore, an aquifer can have a metamorphic description

- Grains size
- Fracturation
- Age
- Consolidation
- Thickness
- Etc...
Voids

Porosity

Hydraulic conductivity

Figure 1: hydro container schema entities

Figure 2: hydro container schema relations

Brodaric and Hahmann, 2014
Example flow system with two subsystems (after Freeze & Cherry, 1978, p. 204)

https://gw-project.org/books/groundwater/

Online books and educational materials free of charge
Flow systems and wells
Wells

OGC 10-004r3 (ISO 19156)
Construction (a.k.a. Borehole)

- Casing
- Filtration
- Sealing
- Screen

At the provincial database site, 4800 or 9600 baud service is suggested with 1200 or 2400 baud service for the drillers and infrequent users. These are speed suggestions based on medium traffic volumes, and they can be increased with no adverse impacts on the groundwater databases. If provincial sub-offices exist, the captured groundwater data could be sent to these sites to reduce the telecommunication charges to a more distant single provincial headquarters site.

December 1991
Already 2 Boreholes specs at OGC
Borehole Interop Experiment

https://xkcd.com/927/

OGC 19-075
Aquifer test (pump test)

Completely modelled as Observations and Measurements and TimeSeries (WaterML 2.0 Part 1)
GWML models

« Technology neutral »

OGC Feature Model

- Conceptual Model (Clause 8)
- Logical Model (Clause 9)
- Physical Model (Clause 11)

OGC Feature Model

- Logical Model
- Physical Model
- Entity-Relation

XSD / XML

- ISO 19118
- OGC 20-012
- PostGresQL

GML / XML (ISO 19136)

- OGC JSON

http://www.opengis.net/doc/IS/GWML/2.2.1
Section 8

Conceptual -> Logical

Section 9

OGC Feature Model

GeoSciML 4.1

SWE

ISO-19115 (Metadata)

Observations and Measurements

Section 8

Section 9
Logical -> Physical

ISO 19118

Section 9

Section 11

Markup Language
Section 11

Data instance
Conclusion

- GWML describes groundwater related features
- Conceptual, Logical and Physical models
- Borrows from other domain standards
  - GeoSciML
  - Observations and Measurements
Thank you!