# OGC HYDRO DOMAIN WORKING GROUP - and WaterML 2.0 suite of standards

Sylvain Grellet – BRGM

25/01/2024

WMO Capacity Building Workshop on Hydrological Data Exchange, Standardization, Interoperability

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# Group dynamics

- Joint OGC – World Meteorological Organization (OMM / WMO) group
  - Memorandum of Understanding between OGC - WMO

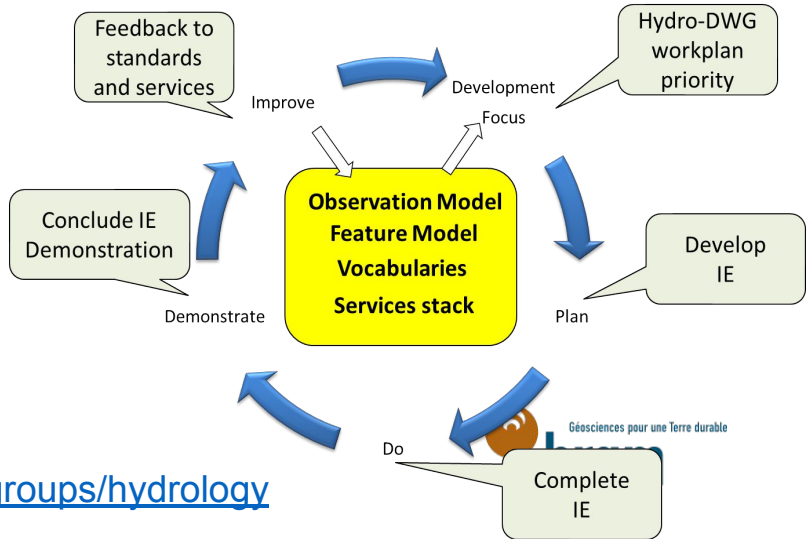
- Target: water data standards => WaterML 2.0 suite : https://www.ogc.org/standard/waterml/
- Organizing Interoperability Experiments - (IEs) focused on the water sub-domains

- Entry point

https://external.ogc.org/twiki_public/HydrologyDWG/WebHome

- Chairs
  - Tony Boston (Australia)
  - Silvano Pecora (Italy) – WMO Liaison
  - David Blodgett (USA)

Iterative Development




http://www.opengeospatial.org/projects/groups/hydrologydwg

# Group dynamics

- A long history of joint activities
  - 2003 - Earth Systems Science Domain Working Group (DWG)
  - 2009 - Hydrology DWG
  - 2011 - Groundwater Interoperability Experiment (IE)
  - 2011 - Water Information Services Concept Development Study
  - 2011 - Surface Water Interoperability IE
  - 2012 - Hydrology Forecasting IE
  - 2013 - Climate-Hydrology Information Sharing Pilot
  - 2013 - GroundWater IE2
  - 2014 - Water ML 2.0 Standards Working Group (SWG)
  - 2015 - Hydrographic Features SWG
  - 2015 - Research Data Alliance Global Water Information IG (Hydro DWG sister group)
  - 2016 - Groundwater SWG
  - 2017 - Geoscience DWG
  - 2018 - Environmental Linked Features IE (ELFIE)
  - 2019 - Borehole IE
  - 2021 - Second ELFIE (SELFIE)
  - 2022 - Water Quality IE => on going



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# Group dynamics

- Un long history of meetings

## First 5 years: Meetings 2008 - 2013

- OGC TC Meeting - Atlanta - 17 September 2008
- OGC TC Meeting - Valencia - 4 December 2008
- OGC TC Meeting - Athens - 30 March 2009
- OGC TC Meeting - Boston - 22 June 2009
- OGC TC Meeting - Darmstadt - 29 September 2009
- OGC TC Meeting - Mountain View - 8 December 2009
- 1st Hydrology DWG Workshop - Ispra - 15-18 March 2010
- OGC TC Meeting - Silver Spring - 15 June 2010
- OGC TC Meeting - Toulouse - 22 September 2010
- Hydrology DWG Workshop - Toulouse - 21-22 September 2010
- OGC TC Meeting - Sydney - 1 December 2010
- OGC TC Meeting - Bonn - 2 March 2011
- 2nd Hydrology DWG Workshop - Delft - 11-14 April 2011
- OGC TC Meeting - Taichung - 15 June 2011
- OGC TC Meeting - Boulder - 19-20 September 2011
- OGC Oceans/Met/Hydro Water Cycle Summit - 21 September 2011
- OGC TC Meeting - Brussels - 29 November 2011
- OGC TC Meeting - Austin - 19 & 21 March 2012
- 3rd Hydrology DWG Workshop 2012 - Reading - 25-28 June 2012
- OGC TC Meeting - Redlands - 16 January 2013
- 4th Hydrology DWG Workshop 2013 - Quebec City - 17-21 June 2013
- OGC TC Meeting - Frascati - 23 September 2013

**Meetings 2014 and later**:

- OGC TC Meeting - Arlington - 24-28 March 2014
- OGC TC Meeting - Geneva - 10-14 June 2014
- 5th Hydrology DWG Workshop 2014 - New York - 11-15 August 2014
- Training workshop at 11th International Hydroinformatics Conference - Standardization of Water Data Exchange: WaterML 2.0 and Beyond - New York - 16 August 2014
- OGC TC Meeting - Boulder - 3 June 2015
- OGC Water Data Summit - Boulder TC - 3 June 2015
- OGC TC Meeting - Nottingham - 17 September 2015
- 6th Hydrology DWG Workshop 2015 - Orleans - 21-25 September 2015
- OGC TC Meeting - Sydney - 2 December 2015
- OGC TC Meeting - Washington - March 2016
- 7th Hydrology DWG Workshop 2016 - Koblenz - 13-17 June 2016
- OGC TC Meeting - Dublin - June 2016
- OGC TC Meeting - Delft - March 2017
- 8th Hydrology DWG Workshop 2017 - Tuscaloosa - 20-23 June 2017
- OGC TC Meeting - St John's - June 2017
- OGC TC Meeting - Palmerston North - December 2017
- OGC TC Meeting - Orleans - March 2018
- OGC TC Meeting - Stuttgart - September 2018
- 9th Hydrology DWG Workshop 2018 - Geneva - 17-20 September 2018
- OGC TC Meeting - Charlotte - December 2018
- OGC TC Meeting - Leuven - June 2019
- Session on HDWG during the ISDE11 - Florence - September 2019 - conference paper
- HydroDWG Seminar January 2021
- HydroDWG Seminar March 2021 - WQ Data
- HydroDWG Seminar August 2021 - Mainstems
- HydroDWG OGC Member Meeting - December 2021
- HydroDWG OGC Member Meeting - March 2022
- GWML2 Workshop March 2022
- Water Quality Workshop March 2022
- HydroDWG OGC Member Meeting - June 2022
- HydroDWG OGC Member Meeting - October 2022
- HydroDWG OGC Member Meeting - February 2023
- HydroDWG Spring 2023 - May 2023

# Group dynamics

- Community
  - Members all across the world
  - Members from different organization types
    - Public administrations
    - Public research organizations
    - International organization
    - Private companies

- Some examples
  - NR-Can, GSC, USGS, US EPA, CUASHI, SDSC, BRGM, UK CEH, DELTARES, GRDC, BaFG, Univ Tartu, Fraunhofer IOSB, DataCove, NIWA/LAWA (NZ), Federation University (Australia), BoM Australia, CSIRO, …
  - WMO, UNESCO, …
  - Kisters, 52°N, Aquatic Informatics, …



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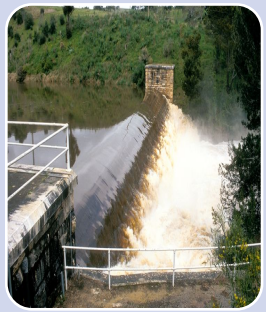
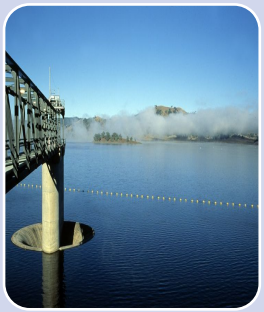
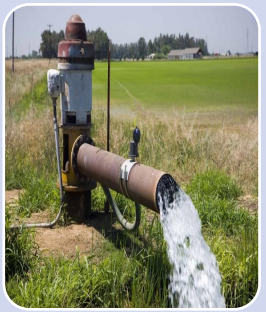
# A suite of standards

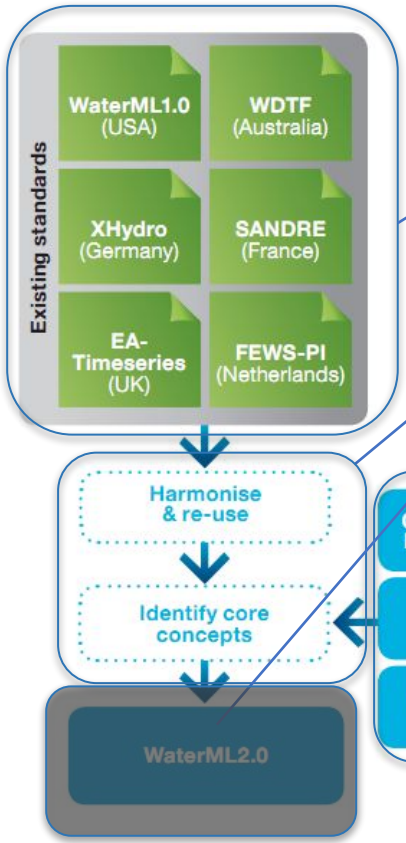
- WaterML2.0
  - Open and documented
  - implemented in WMO Information System and in many organizations : UNESCO, USGS, US EPA, NrCan, NIWA, BRGM, etc…
  - And in opensource tools : CUASHI Hydro-Server, Kisters, 52°N etc…
  - Updated with a regular contribution from projects involving Hydro DWG partners


| Part 1 - Timeseries | Part 2 – Ratings, Gaugings and Sections | Part 3 – Surface water features | Part 4 – Groundwater | Part 5 – Water quality (best practice) Soon to be updated by the Water Quality IE |
|---|---|---|---|---|

# WaterML2: Part 1 – Timeseries Harmonization

- https://portal.ogc.org/files/?artifact_id=57222




Scope

Requirements

Design

**WaterML 2.0: Part 1 –Timeseries**

Do Work

Constraints

*A new environment*

Best practices

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# WaterML2: Part 1 – Timeseries Harmonization

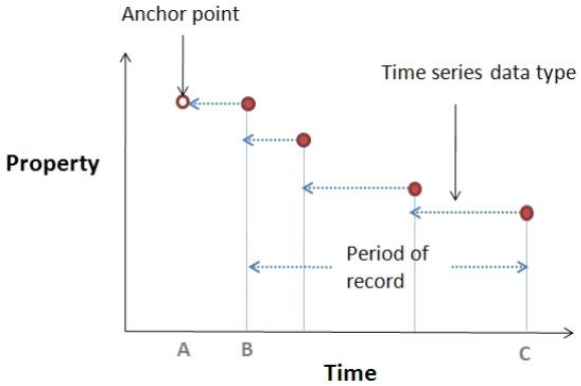
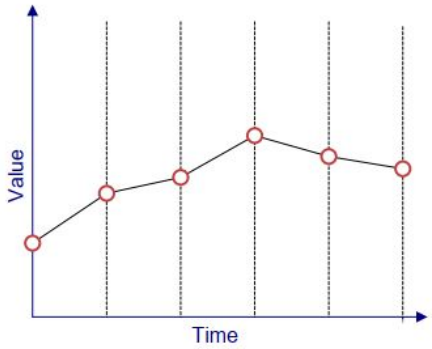



Figure 24 - Anchor points




A continuous time series indicates the observation result is the value of a property at the indicated instant in time. The points are essentially connected and interpolation may occur between points in order to estimate the value of the property between points. The appropriate time spacing between successive points to minimise interpolation errors is related to rate of change (wrt time) of the property.

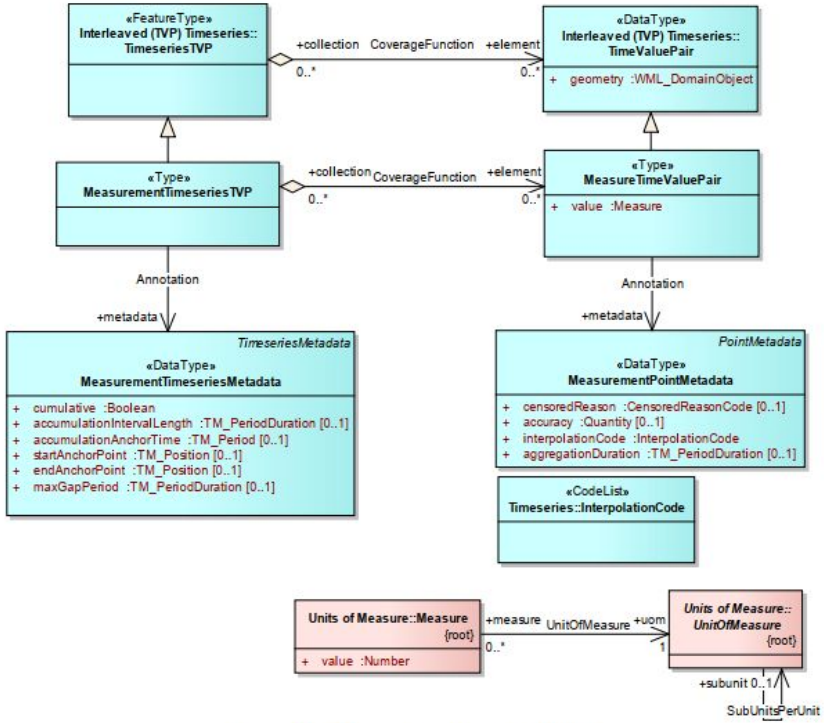



Figure 23 - Measurement Timeseries (TVP)

Contributed to the birth of OGC TimeSeries ML
https://www.ogc.org/standard/tsml/

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# WaterML2: Part 1 adoption

- WaterML2 announcement regarding US national strategy for civil earth observations (2013)
  - http://www.opengeospatial.org/pressroom/pressreleases/1831
- US Federal Geographic Data Committee (FGDC) endorses WaterML2 (2014)
  - http://www.fgdc.gov/standards/news/WaterML
- WaterML2 recommended in EU legislation on data sharing (2013) => INSPIRE
  - http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:331:0001:0267:EN:PDF
- USGS implements WaterML2 in Water Information System (2014)
  - http://help.waterdata.usgs.gov/news/april-10-2014
- BoM (Bureau of Meteorology) supports WaterML2 via Water Data Online (2017)
  - http://www.bom.gov.au/waterdata/
- WMO implements it natively in its Information System
- And others …



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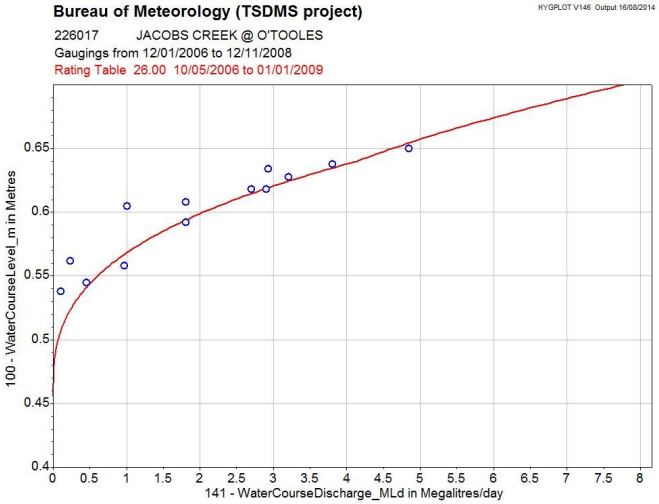
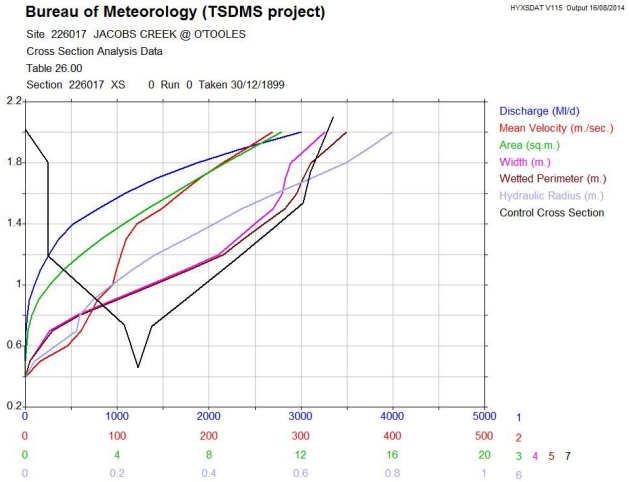
# WaterML2: Part 2 – Ratings, Gaugings and Sections

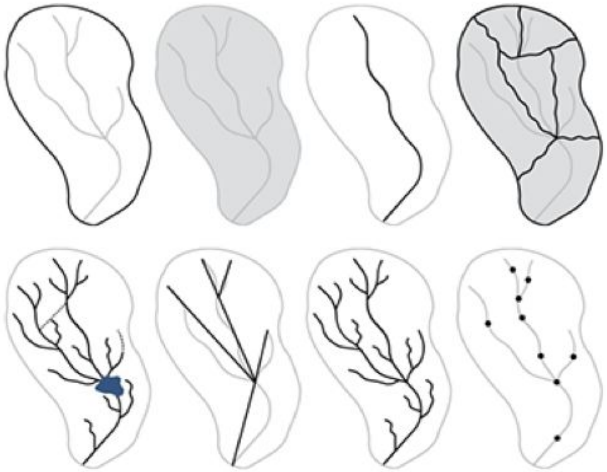
- Encodes rating conversions (e.g. stage to discharge), gauging observations and river cross
- https://docs.ogc.org/is/15-018r2/15-018r2.html



# WaterML2: Part 3 – Surface Hydrology Features

- Conceptual model describing surface water hydrologic features such as rivers, lakes, catchments
- https://docs.ogc.org/is/14-111r6/14-111r6.html



- Catchment Boundary
- Catchment Area
- Flowpath
- Contained Catchments

- Cartographic Realization
- Topological Schematic
- Hydrographic Network
- Hydrometric Network



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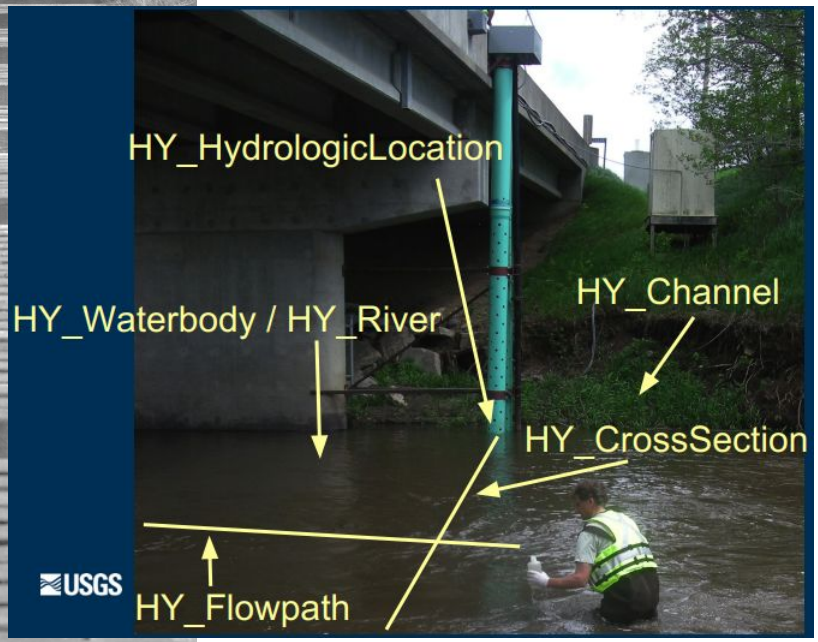
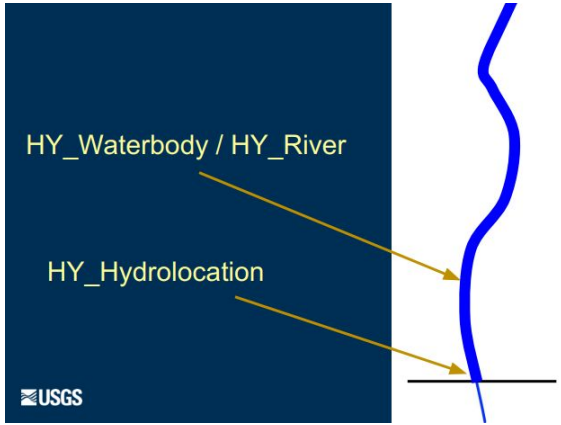
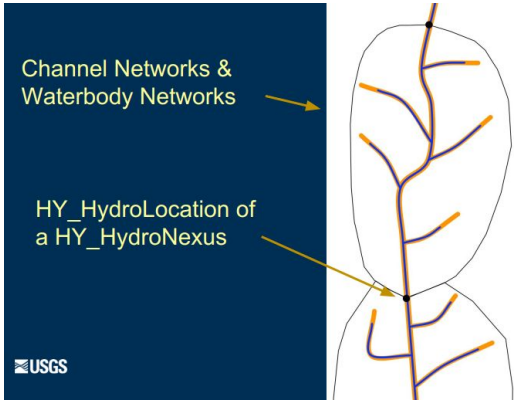
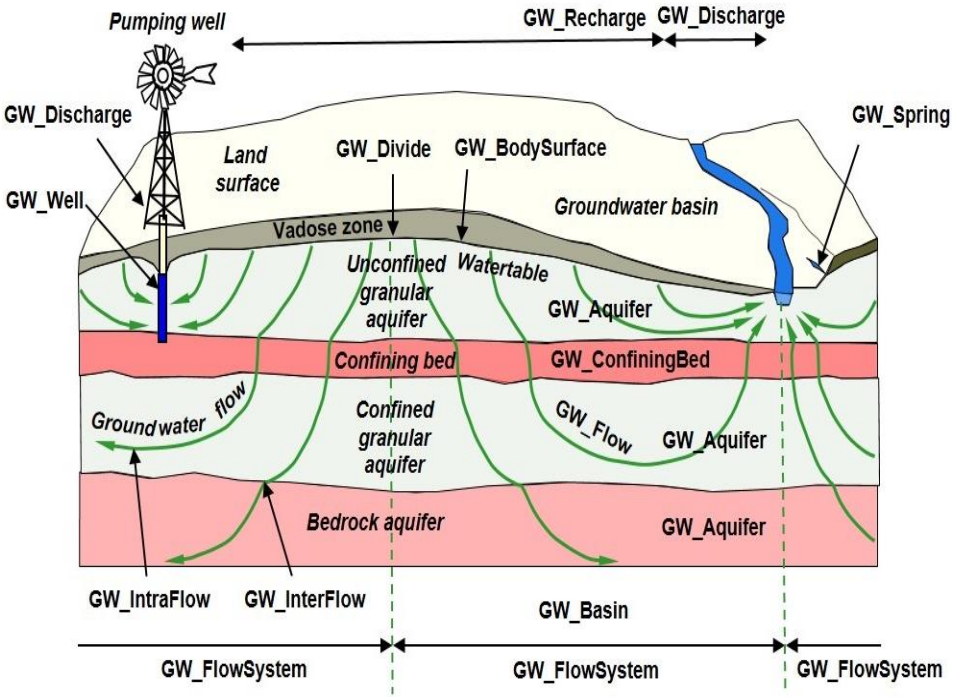


# WaterML2: Part 4 – GroundWater Markup Language 2 (GWML2)

- Conceptual and logical model describing surface water hydrologic features such as rivers, lakes, catchments
- https://docs.ogc.org/is/16-032r2/16-032r2.html




- Hydrogeological units,
- Aquifers,
- Voids,
- Fluid bodies,
- Hydraulic conductivity,
- Water wells,
- Springs

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# WaterML2: Part 4 – GroundWater Markup Language 2 (GWML2)

- Conceptual and logical model describing surface water hydrologic features such as rivers, lakes, catchments
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## Hydrogeological units, fluid bodies

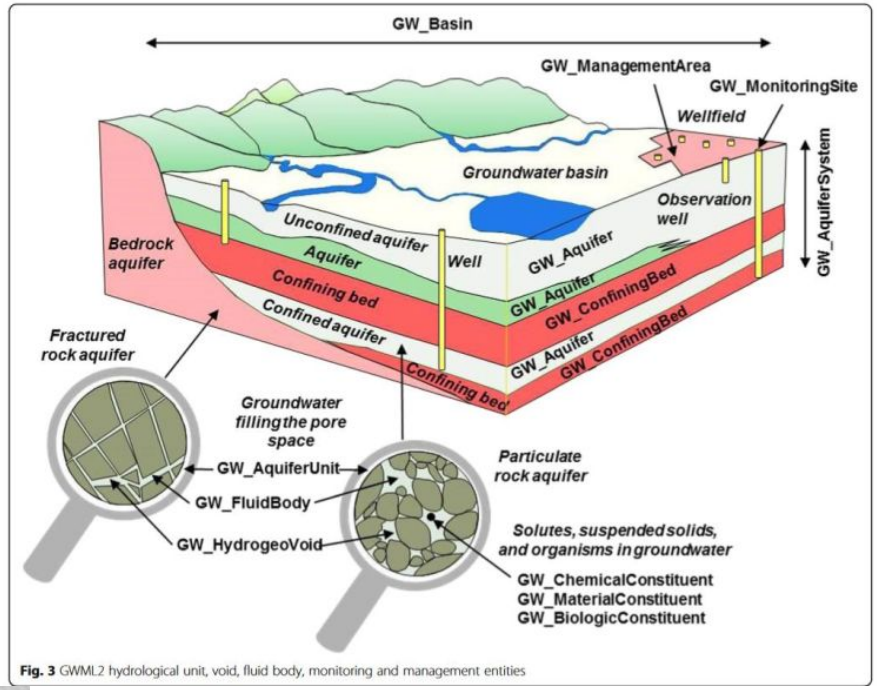
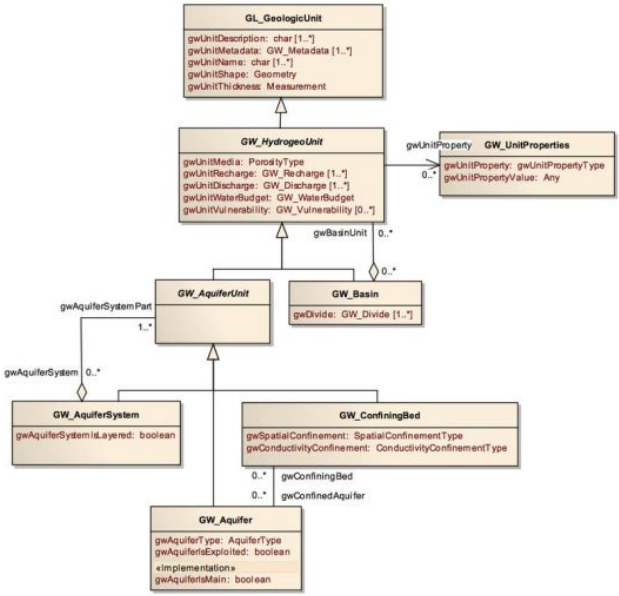



Fig. 3 GWML2 hydrological unit, void, fluid body, monitoring and management entities

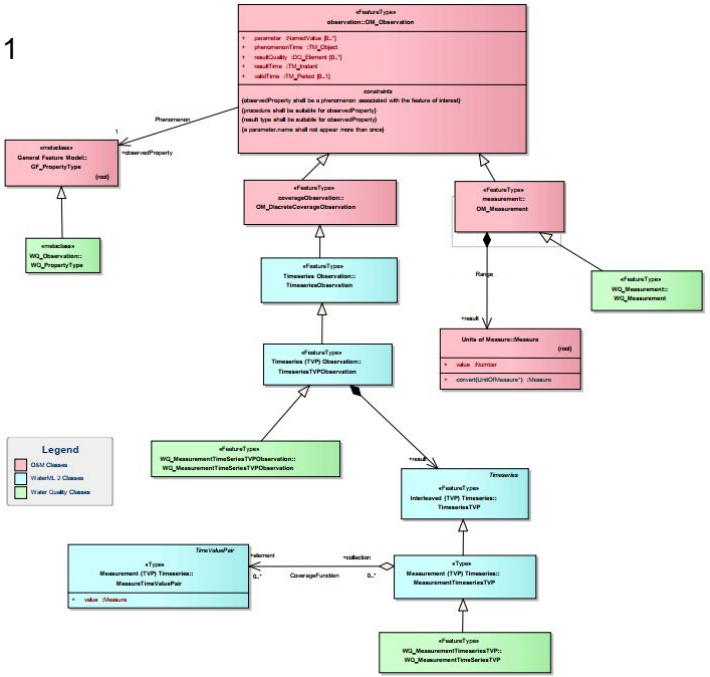


# WaterML2: Part 5 – Water Quality Best Practice

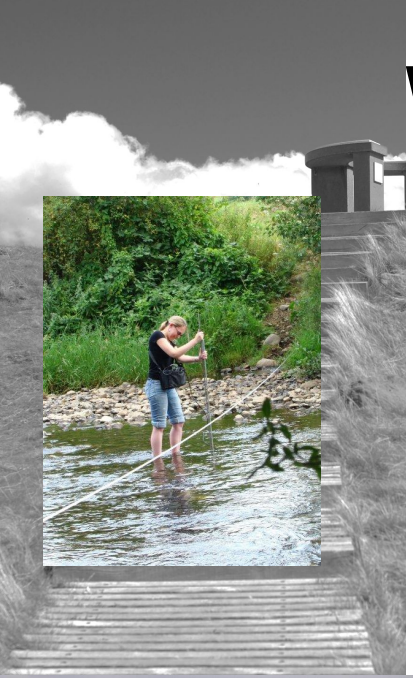
- WaterML-WQ – an O&M and WaterML 2.0 profile for water quality data
- https://docs.ogc.org/bp/14-003/14-003.html

- Scope
  - Observations & Measurements and WaterML2 – Part 1 specialisation for time series of chemical concentrations
  - Beginning of work on ‘Water quality’ vocabularies based on QUDT, ChEBI, NVS P01, S06 I-ADOPT

⇒ Currently being updated by the running Water Quality Interoperability Experiment



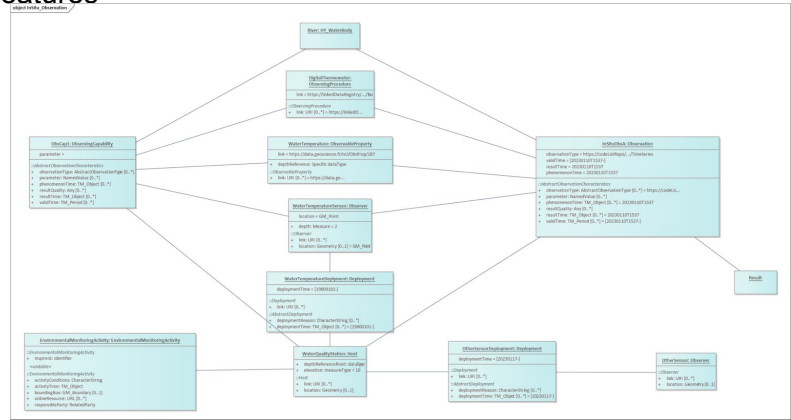
# WaterML2: Part 5 – Water Quality Best Practice



- OGC Water Quality Interoperability Experiment : https://github.com/opengeospatial/WaterQualityIE
  - Co-Lead : BRGM, Internet of Water
  - Membres: USGS, US EPA, WMO, UNESCO, BfG, BRGM, OFB - Pôle INSIDE, University of Tartu, Australia & NZ participants
  - Scope
    - Sharing water quality data (surface or ground water) between organisations
    - Types of water data : in-situ sensors, one time measurements, samples (and sub-samples), lab analysis, biodiversity observations and associated vocabularies
    - ‘OGC Baseline’
      - Semantics: “Observations, Measurements & Samples”
      - API : SensorThings API, OGC API - Features

La Dordogne – Pont de Lalinde – Août 2005

La Dordogne – Février



# Merci

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# Thanks to


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