UN WATER
INTEGRATED MONITORING INITIATIVE FOR SDG 6

SUSTAINABLE DEVELOPMENT GOALS

UN environment programme

GEMS Water

In-situ water quality data harmonization and sharing Challenges and opportunities

Philipp Saile, Head of UNEP GEMS/Water Data Centre

In situ calibration and validation of satellite products of water quality and hydrology

20.05.2021

UN environment programme

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

Rialtas na hÉireann Government of Ireland

UNESCO United Nations Educational, Scientific and Cultural Organization

International Centre for Water Resources and Global Change under the auspices of UNESCO

bfg Bundesanstalt für Gewässerkunde

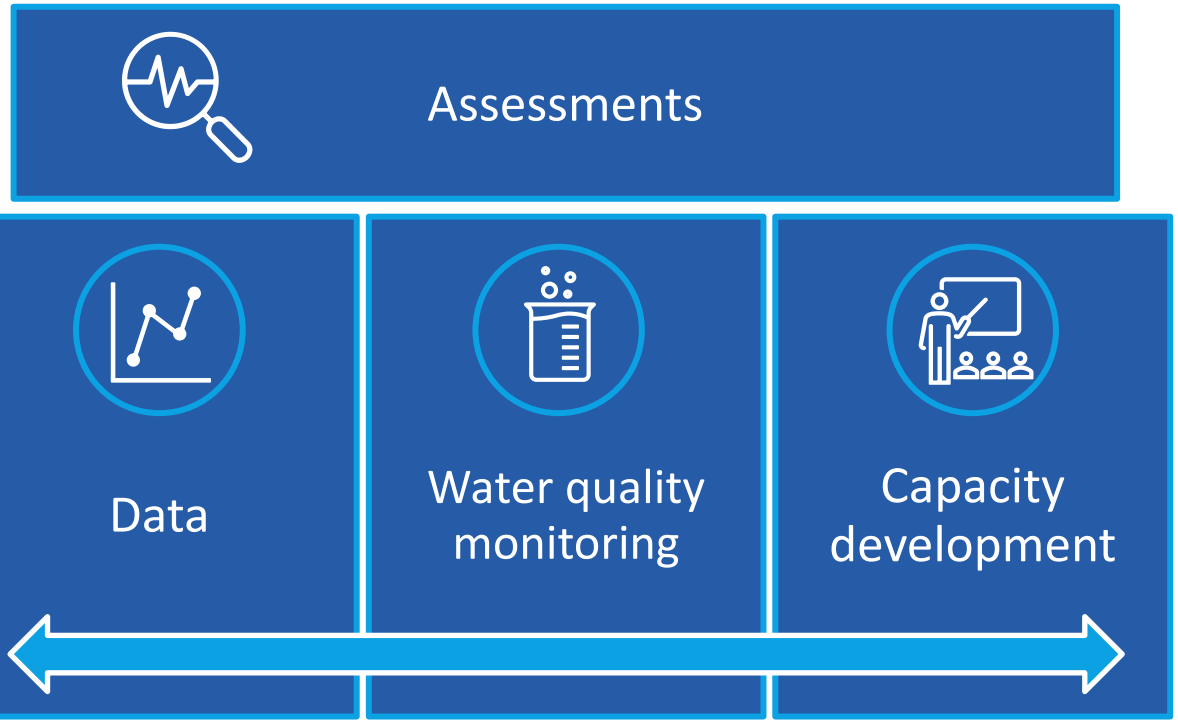
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

The UNEP Global Environment Monitoring System for Freshwater (GEMS/Water)

2014: UNEA Res. 1/9
⇒ GEMS/Water
2018: UNEA Res. 3/10
⇒ WWQA
⇒ SDG 6

GEMS/Water Coordination Unit
Nairobi, Kenya

WWQA
World Water Quality Alliance



GEMS/Water Data Centre
Koblenz, Germany

United Nations Educational, Scientific and Cultural Organization
International Centre for Water Resources and Global Change under the auspices of UNESCO

bfg Bundesanstalt für Gewässerkunde

GEMS/Water Capacity Development Centre
Cork, Ireland

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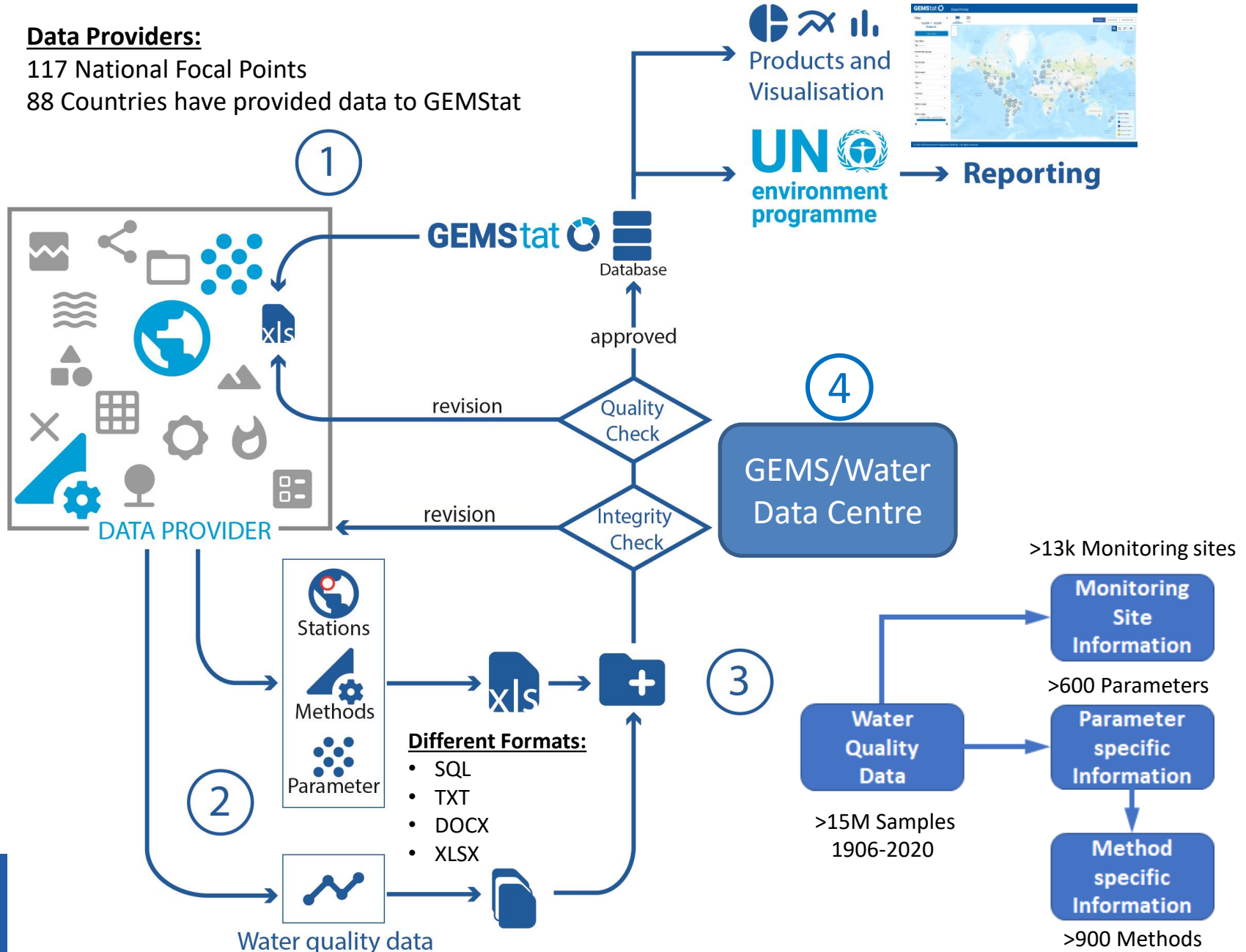
The global water quality database and information system GEMStat

Data Providers:
117 National Focal Points
88 Countries have provided data to GEMStat



Data Submission Workflow

1. Data Provider receives templates for reporting metadata on monitoring locations, water quality parameters and analytical methods
2. Data Provider compiles information on monitoring locations, water quality parameters and analytical methods, and establishes relation between their water quality data and these three entities.
3. Data Provider submits registration template with above three entities and their water quality data.
4. GEMS/Water Data Centre checks integrity of relationships between water quality data and entities, registers new entities where necessary within GEMStat database and checks quality of data submission.

Challenges for harmonizing and sharing water quality data

Example dataset from Lake Victoria

Sampling parameters

STATION	Date	Time	Long.	Lat.	Depth	Secchi	TA	TH	DO	Turb	Cond	pH	Redox	Temp
Samunyi RM	18-Dec-13	09:49	34.41647	-0.51892	1.3	0.62	68	38	2.26	25.7	160.5	7.41	17	24
Oluch RM	18-Dec-13	11:33	34.50118	-0.46207	2	0.34	62	40	6.97	289	152.5	7.87	-49	26.2
Mirunda (RM)	19-Dec-13	12:19	34.34233	-0.49338	1.4	0.4	44	62	7.32	248	148.3	7.71	-31	28.7
Sori	20-Dec-13	14:33	34.16403	-0.84513		1.2	40	36	6.6	107	6.26	7.33	-18	27.3
kuja RM	21-Dec-13	10:50	34.14307	-0.90677	1	0.1	52	40	3.8	310	116.3	6.29	26	23.9
Kadimo Bay (Anyanga)	22-Dec-13		34.0908	-0.08544	1.2	1.1	46	24	7.35	7.16	106	8.48	-61	27.6
Usenge Beach	22-Dec-13	18:06	34.06362	-0.07072		1.5	36	66	6.44	2.69	107.6	7.61	-26	27.8
Yala RM (Goye)	23-Dec-13	07:31	34.03563	-0.06894	1		48	56	3.08	3.9	104.5	6.82	5	25.3
Bulwani	23-Dec-13	10:22	33.99582	0.00707	2.3	1.1	42	34	1.47	6.51	86.1	6.92	43	23.4
Sio RM	23-Dec-13	16:05	34.00782	0.21936	1.2	0.8	42	34		11.6	113.5	7.95	-25	27.6
Lwanda Kotieno	24-Dec-13	13:42	34.29225	-0.38361		1.2	46	42	6.78	11.9	127.4	6.99	9	27.9
Asembo Bay	25-Dec-13				3.1	0.4	64	44	6.81	47.7	149.8	7.72	-44	25.8
Nyando RM	26-Dec-13	09:57	34.83022	-0.2623	1.8	0.3	112	66	3.77	61.2	184.7	6.88	16	26.9
Kisumu Bay	26-Dec-13	12:09	34.44568		1.9	0.1	264	44	6.15	85.9	159	7.48	-2	25.7
Homa bay	19-Dec-13	09:36	34.27764	0.30916	3.88	0.6	64	56	5.33	27	154.6	7.84	-42	25.8
Got Kachola	21-Dec-13	09:28	34.1355	-0.93565	0.5		50	44	1.03	4.43	95	7.12	11	24.5
Bridge Island	22-Dec-13	10:36	34.06792	-0.2068	39.8	2.7	44	44	6.5	2.69	104	7.1	5	25.4
Asat RM	25-Dec-13	11:06	34.5165	-0.18528	1.6	0.4	60	68	5.92	69	153	7.51	-25	26.7
Kendu Bay	25-Dec-13	15:56	34.67217	-0.35298	1.5		62	42	4.4	79.6	158.1	7.15	19	28.6
Fisheries Pier	26-Dec-13				1.9	0.1	264	44	11.83	27.3	169.7	8.48	-75	31.6

Unclear metadata

- Parameters?
- Reference systems?

Missing metadata

- Units?
- Methods?
- Station metdata
  - Water body type

… and Opportunities

- Use open application schemata/ontologies to encode water quality (meta)data
- Use linked water quality vocabularies to facilitate harmonization and interoperability:
  - Water quality parameters
  - Units
  - Sampling and analytical methods
  - Data quality, …
- Provide access through standard protocols/web services and formats
- Publish data using (open) licenses

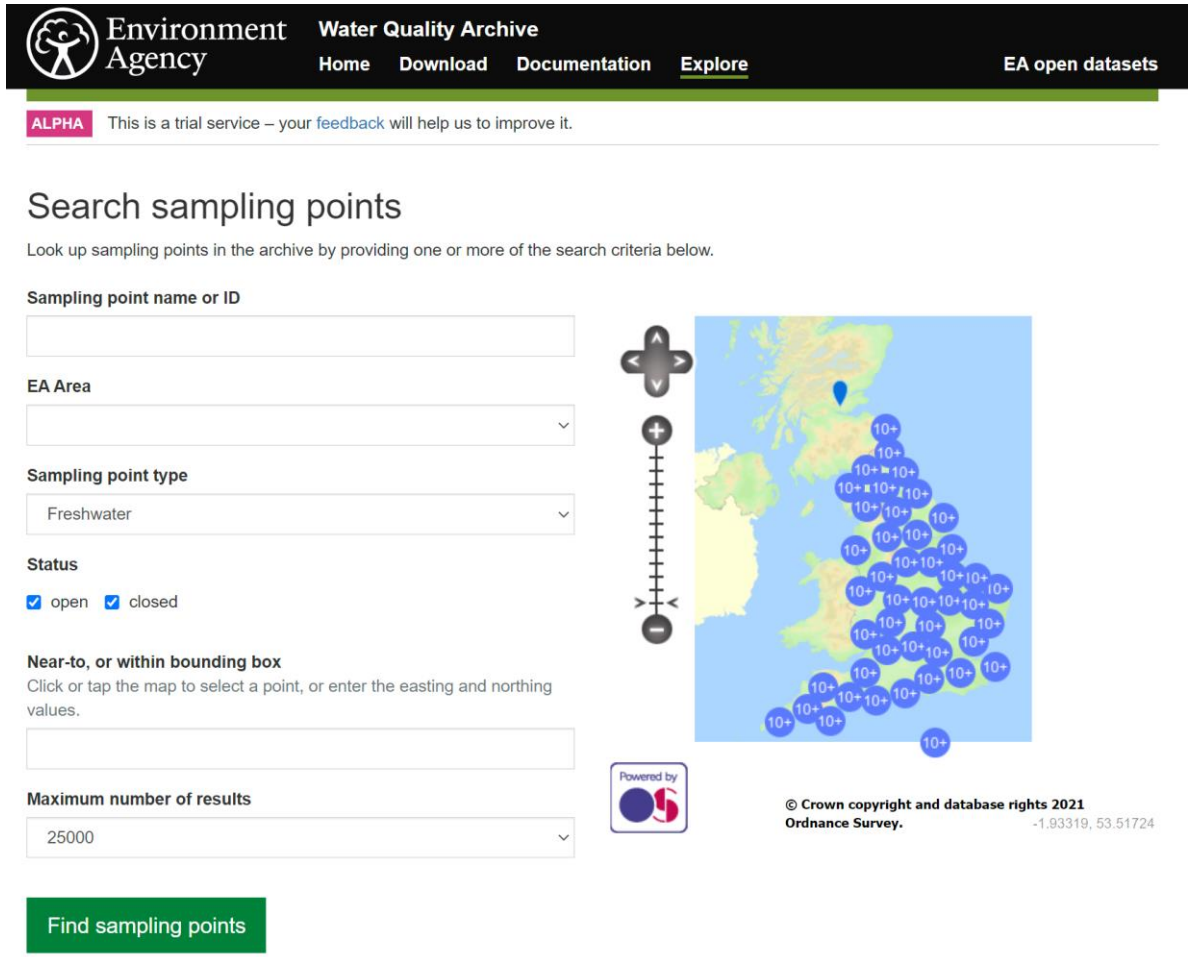
FAIR data principles

https://www.ands.org.au/working-with-data/fairdata/training, CC-BY 4 International

FAIR water quality data - The UK Water Quality Archive

- Use open application schemata/ontologies to encode water quality (meta)data ✓
- Use linked water quality vocabularies to facilitate harmonization and interoperability:
  - Water quality parameters: https://environment.data.gov.uk/water-quality/def/determinands.html?_limit=100&_sort=label ✓
  - Units: https://environment.data.gov.uk/water-quality/def/units.html?_sort=label ✓
  - Sampling and analytical methods ✗
  - Data quality, … ✗
- Provide access through standard protocols/web services and formats ✓
  - REST API => JSON, CSV, RDF
- Publish data using (open) licenses ✓
  - UK Open Government License

https://environment.data.gov.uk/water-quality/view/landing

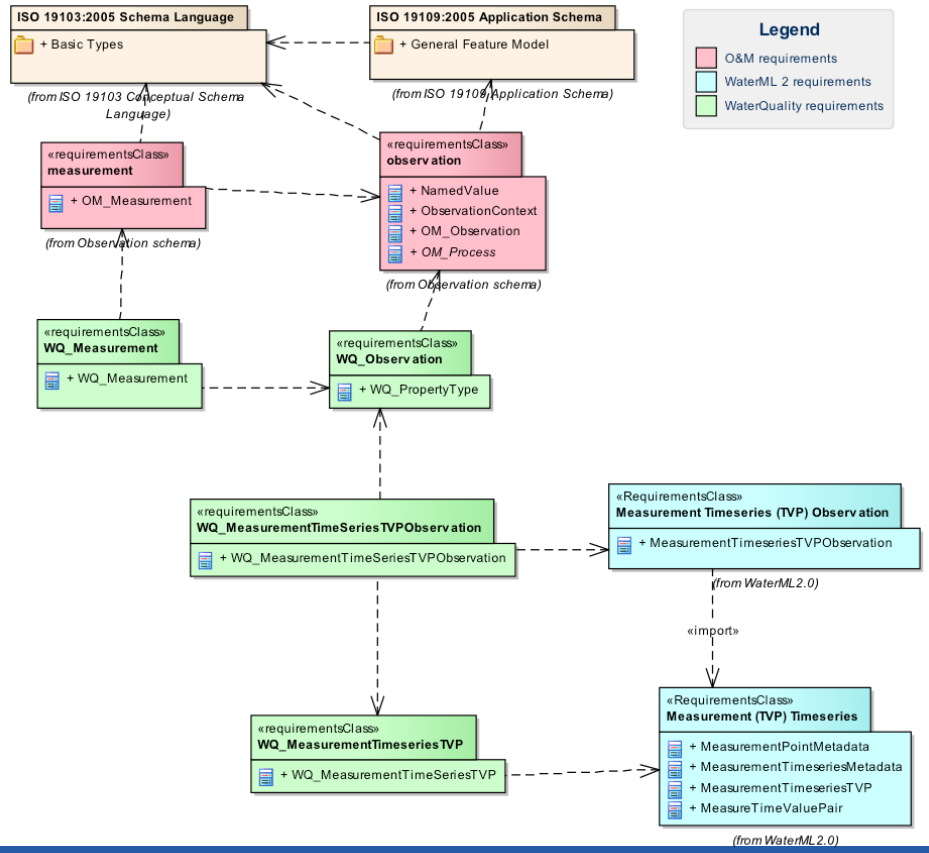


Reusable water quality data – Community standards

OGC WaterML- WQ

http://docs.opengeospatial.org/bp/14-003/14-003.html

1. single measurements of a single water quality parameter, where the result is a scalar value
2. multiple measurements of a single water quality parameter related to a single location, where the result is organized into a time-series, as time-value pairs (TVP).



W3C/OGC Semantic Sensor Network Ontology

https://w3c.github.io/sdw/ssn/

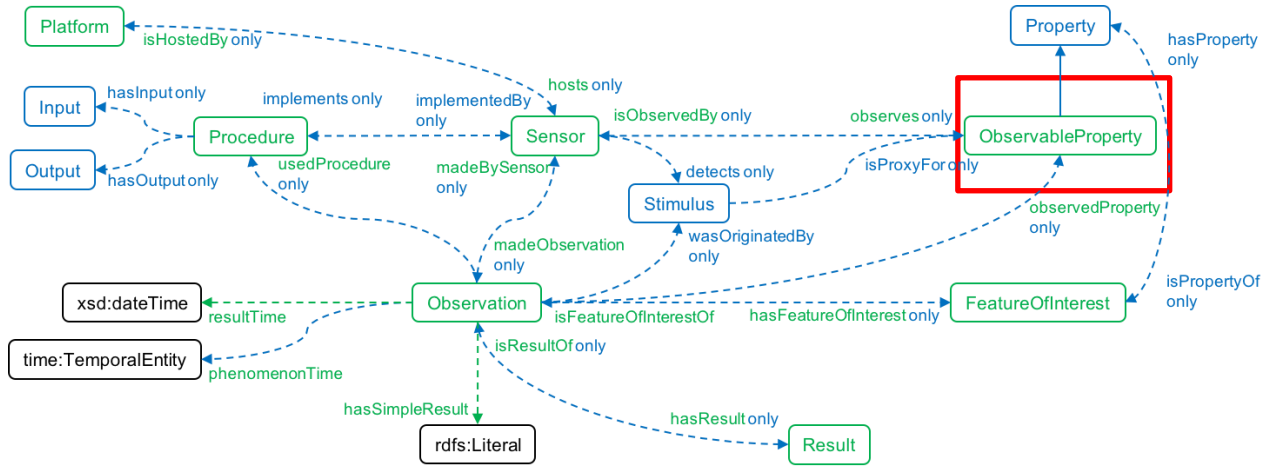


Figure 10 *Classes and relationships involved in Observation (SOSA/SSN)*

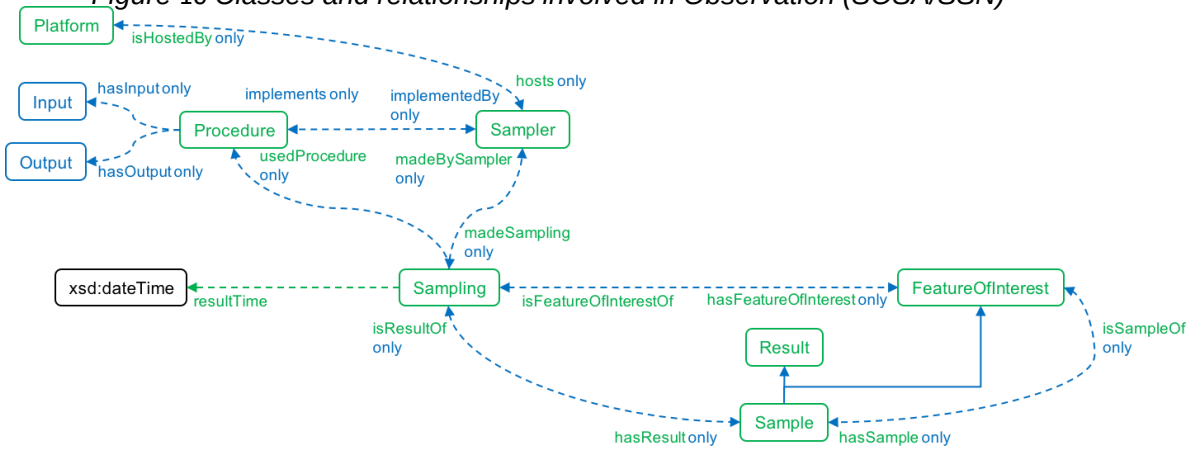
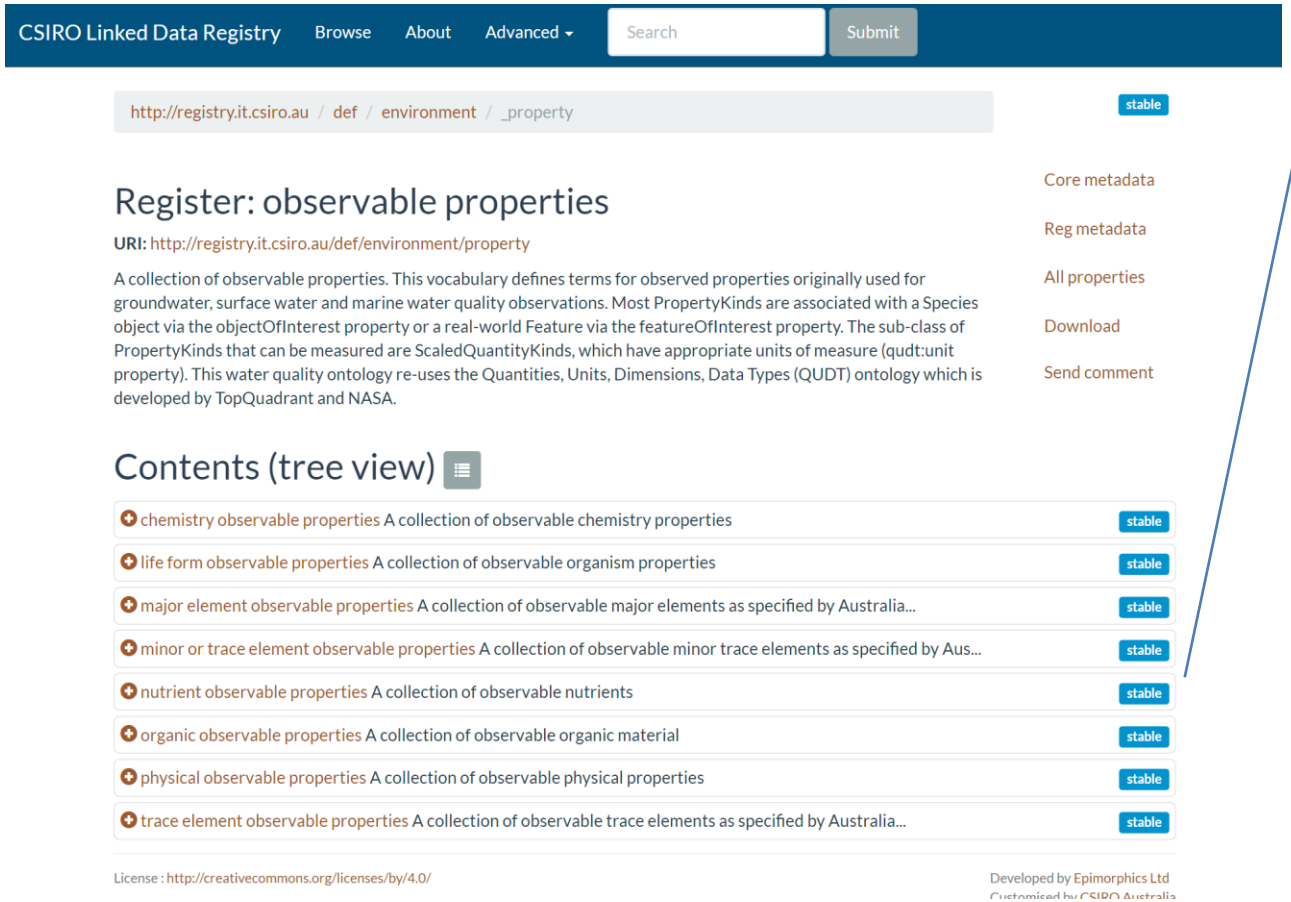


Figure 14 *Classes and relationships involved in Sampling (SOSA/SSN)*

Interoperable water quality data – FAIR vocabularies

eReefs Observable Property vocabulary

http://registry2.it.csiro.au/def/property



SKOS vocabulary based on existing ontologies QUDT + ChEBI

http://registry2.it.csiro.au/def/property/_nitrogen_concentration

Resusable water quality data - Licensing

Restricted
- Only for UNEP use, not shared

Limited
- Attribution of data providers, non-commercial use
- CC BY-NC 4.0

Open
- Attribution of data providers
- CC BY 4.0

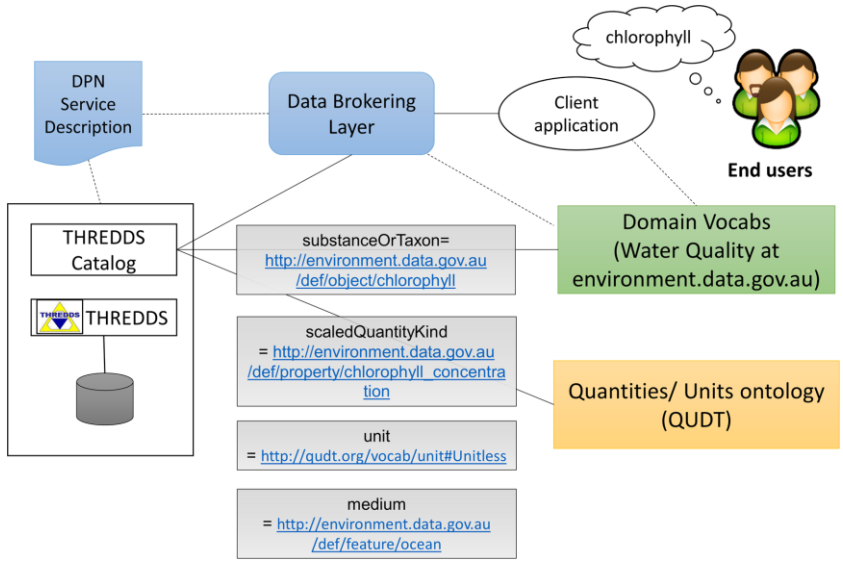
Public Domain
- Not used yet => CC C0

Future directions

- Publish GEMStat database under Open Data Commons Open Database Licence
- Publish contents under respective data provider licenses

Recommendations to improve data harmonization and sharing

- Further develop and publish upper-level ontologies/vocabularies for water quality parameters, analytical methods, …
  - Governance?
- Encourage data providers to share data as open as possible referencing international licenses (compatible)
  - Creative Commons or Open Data Commons
- Further develop and agree upon standard protocols and formats for making data accessible
  - OGC data format standards (WaterML 2 WQ)
  - OGC APIs (SOS, EDR)
- Develop tools to deal with complex standards



Thank you for your attention!

Contact:
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GEMStat

https://gemstat.org