WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Region VI Capacity Building 29 January 2024 (online) WHOS latest advancements

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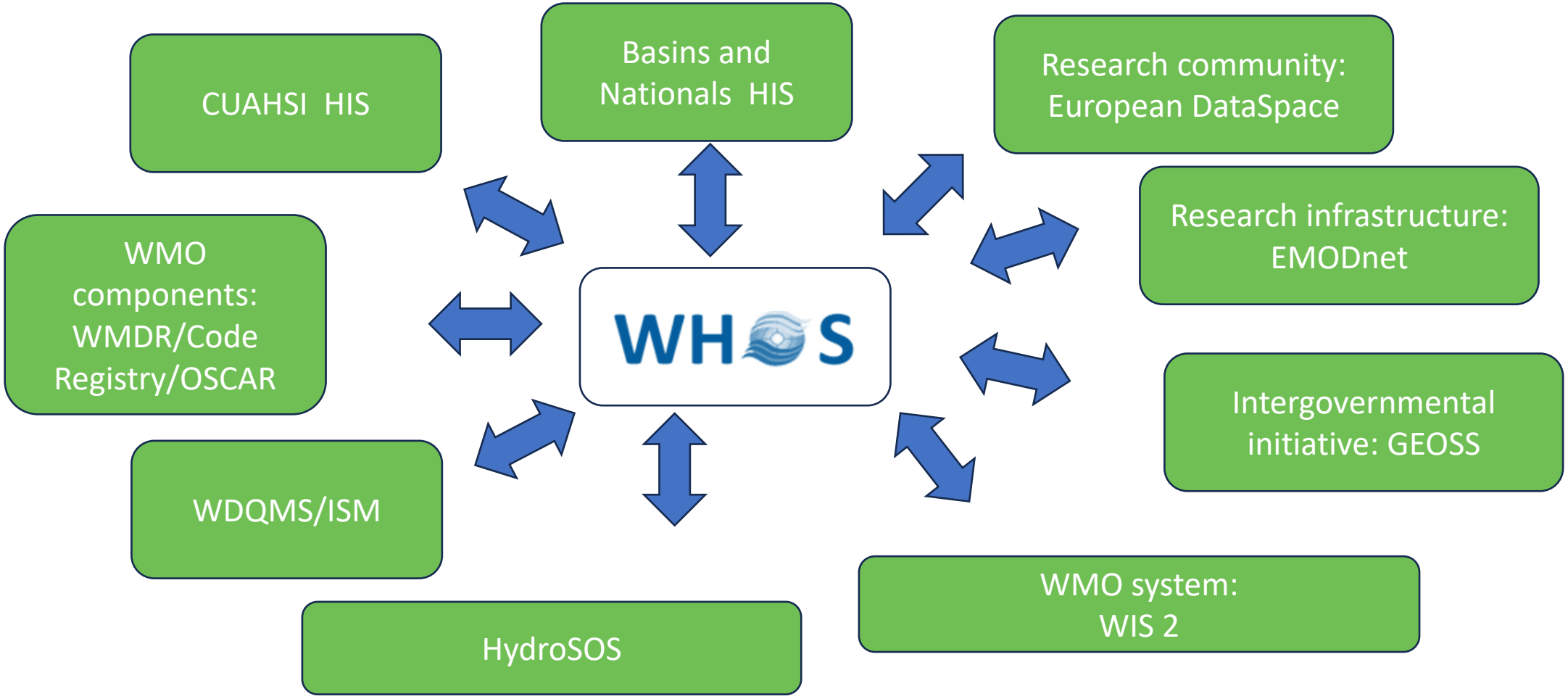
Washington Otieno – WMO Secretariat

WMO OMM
World Meteorological Organization
Organisation météorologique mondiale

Thanks to its brokering approach, interoperability with different tools is eased.
Different communities can easily contribute to WHOS.
WHOS data can be disseminated to other communities.



CUAHSI Hydrological Information System (CUAHSI-HIS)

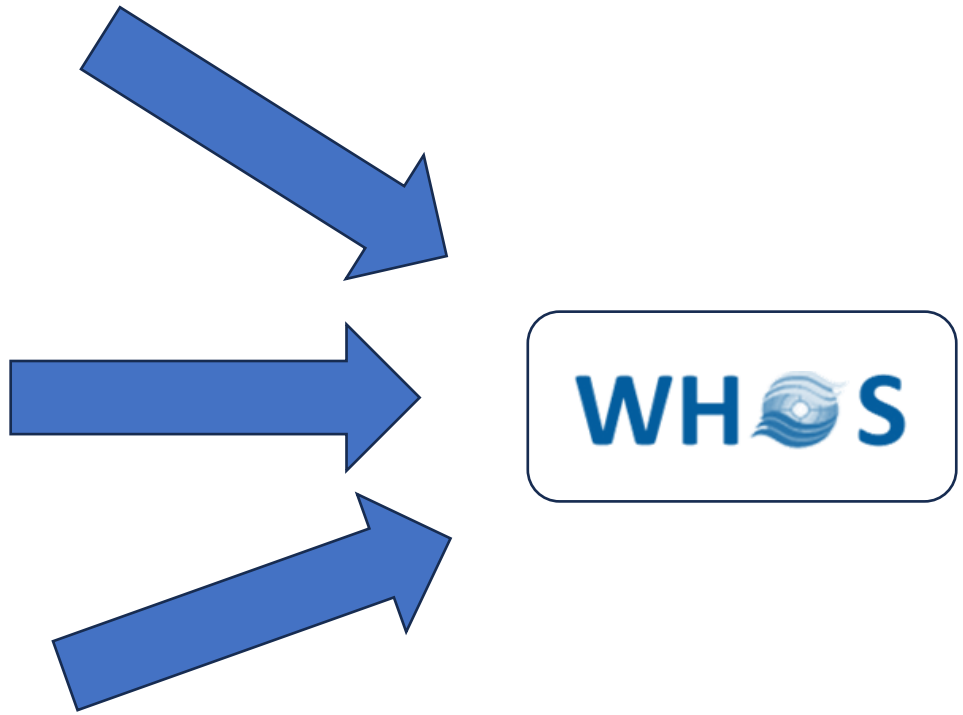
- (USA) Consortium of Universities for the Advancement of Hydrologic Science, Inc.
- 102 originator organizations
- 3,892,000 time series

OGC SensorThings services

- IOT ready
- Many initiatives and data providers are implementing it
  - BRGM
  - HydroServer 2

GRDC

- OGC SOS v.2.0
- Global run-off data center
- Historical data



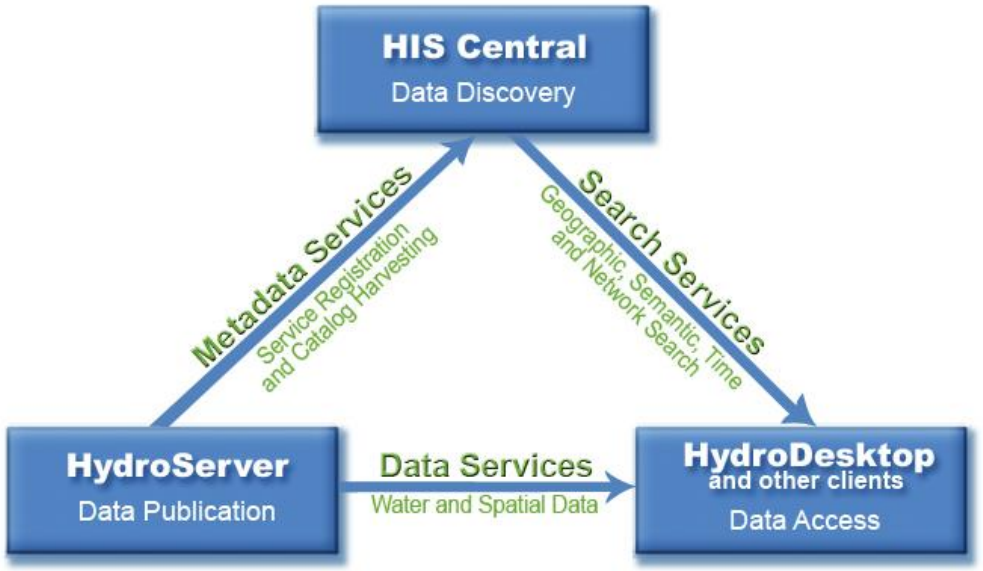
CUAHSI Hydrological Information System (CUAHSI-HIS)

- (USA) Consortium of Universities for the Advancement of Hydrologic Science, Inc.
- 102 originator organizations
- 3,892,000 time series

An organization representing more than one hundred United States universities, receives support from the National Science Foundation to develop infrastructure and services for the advancement of hydrologic science and education in the U.S.

HIS = Hydrologic Information System

CUAHSI HIS WaterOneFlow Services

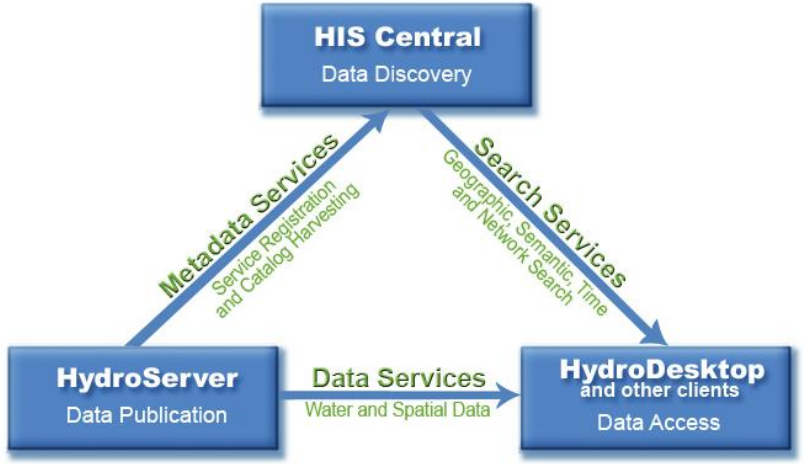


Water data from a variety of sources are:

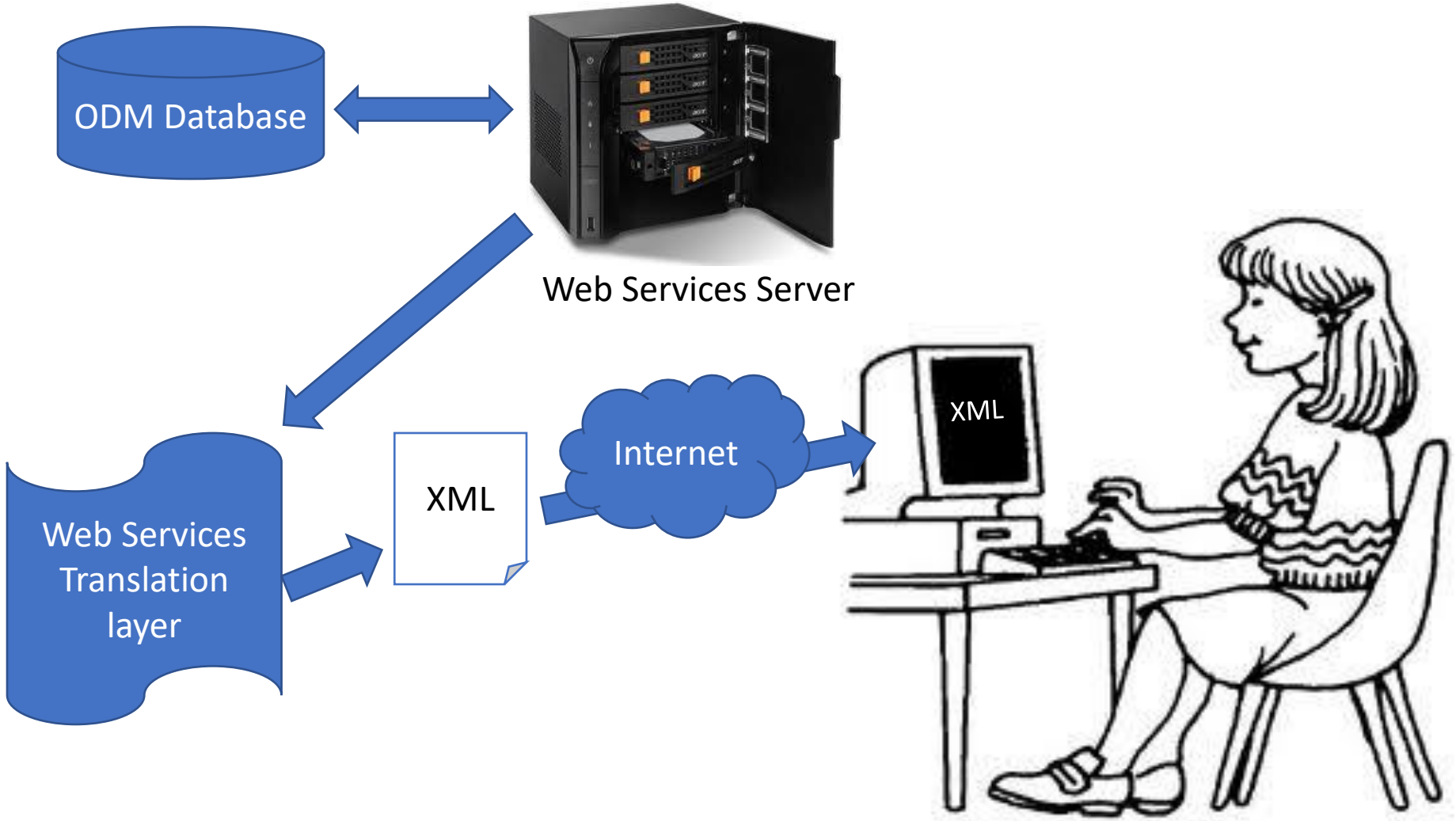
- **hosted** on servers (**HydroServers**)
- **cataloged** into a central metadata database (**HIS Catalog**)
- **discoverable** through the use of client applications (such as **HydroDesktop**).

CUAHSI HIS

- **Federated architecture**: all the data providers must install HydroServer and register to the HIS Central registry
- User search for data providers on the HIS Central, then bind to the matching HydroServer to download the data

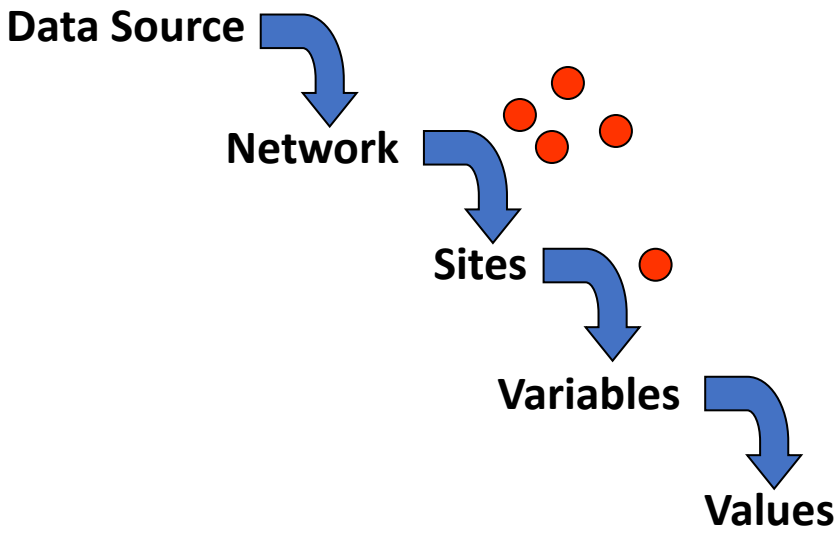


HydroServer Approach



WaterOneFlow web service

- Set of **query** functions
  - Get Sites
  - Get Site Info
  - Get Variable Info
  - Get Values
- returns data in **WaterML**



For example: to get a site, send this “SOAP” request to the server:

```
POST /wateroneflow/NWIS/UnitValues.asmx HTTP/1.1
Host: river.sdsc.edu
Content-Type: text/xml; charset=utf-8
Content-Length: length
SOAPAction: "http://www.cuahsi.org/his/1.0/ws/GetSiteInfo"

<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-ir
  <soap:Body>
    <GetSiteInfo xmlns="http://www.cuahsi.org/his/1.0/ws/">
      <site>string</site>
      <authToken>string</authToken>
    </GetSiteInfo>
  </soap:Body>
</soap:Envelope>
```

Specify the site and an optional authorization token

Get this response:

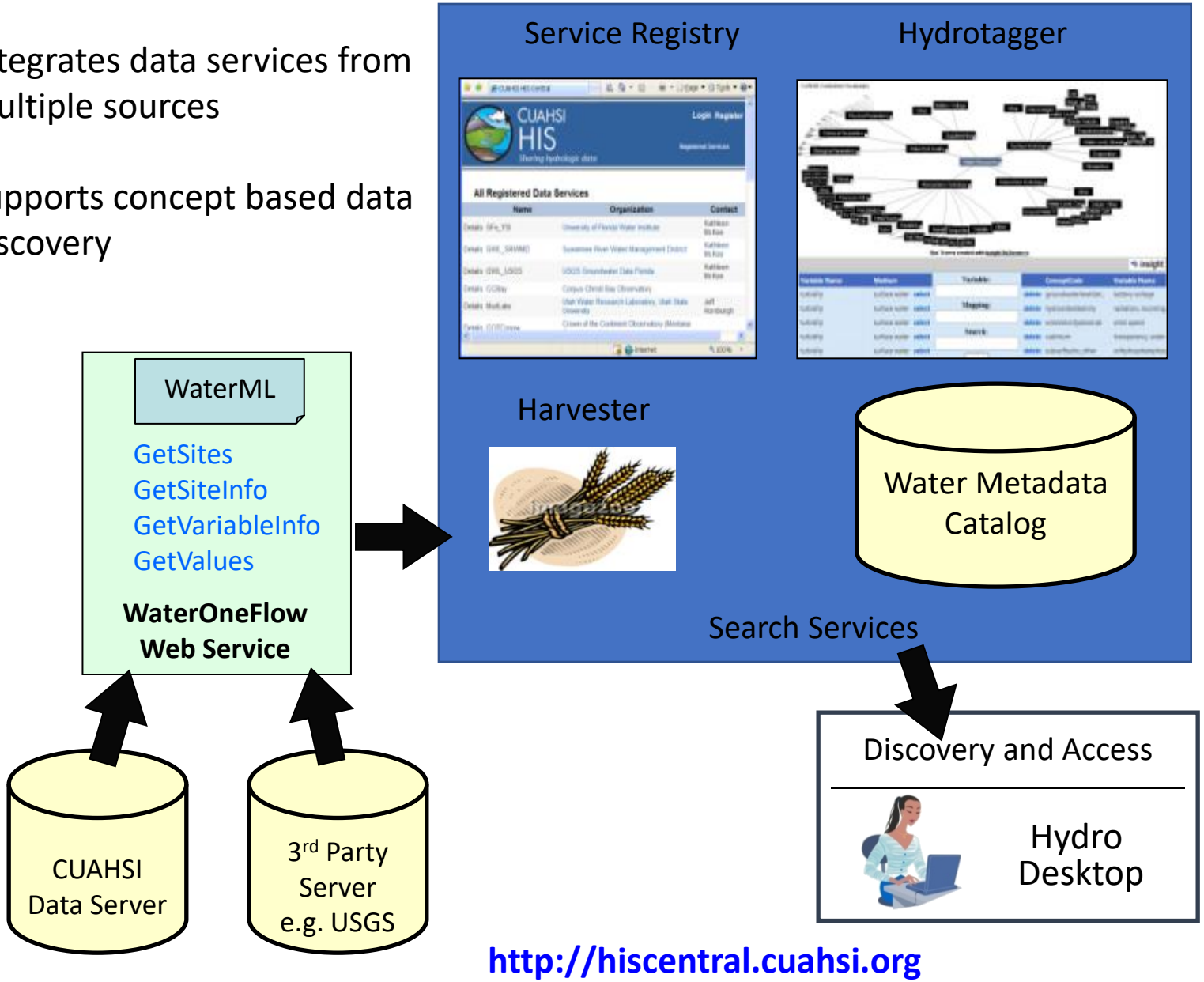
```
HTTP/1.1 200 OK
Content-Type: text/xml; charset=utf-8
Content-Length: length

<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLS
  <soap:Body>
    <GetSiteInfoResponse xmlns="http://www.cuahsi.org
      <GetSiteInfoResult>string</GetSiteInfoResult>
    </GetSiteInfoResponse>
  </soap:Body>
</soap:Envelope>
```

Result returns in this string.

HIS Central Catalog

- Integrates data services from multiple sources
- Supports concept based data discovery



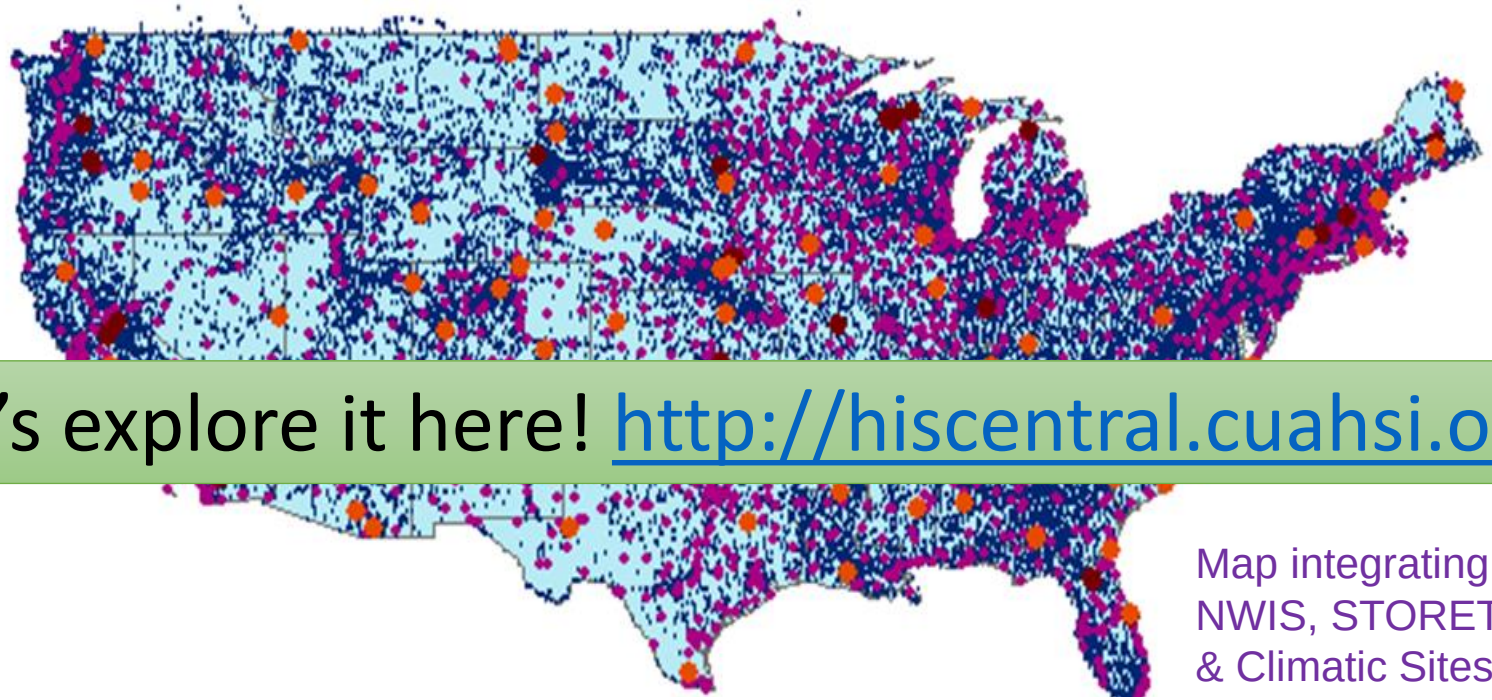
http://hiscentral.cuahsi.org

HIS Central *Web Service*

- Programmatic methods to query the national metadata catalog
- Search by:

- Location
- Variable
- Date Range
- Data source

HIS Central Content



Let's explore it here! http://hiscentral.cuahsi.org

Map integrating
NWIS, STORET,
& Climatic Sites

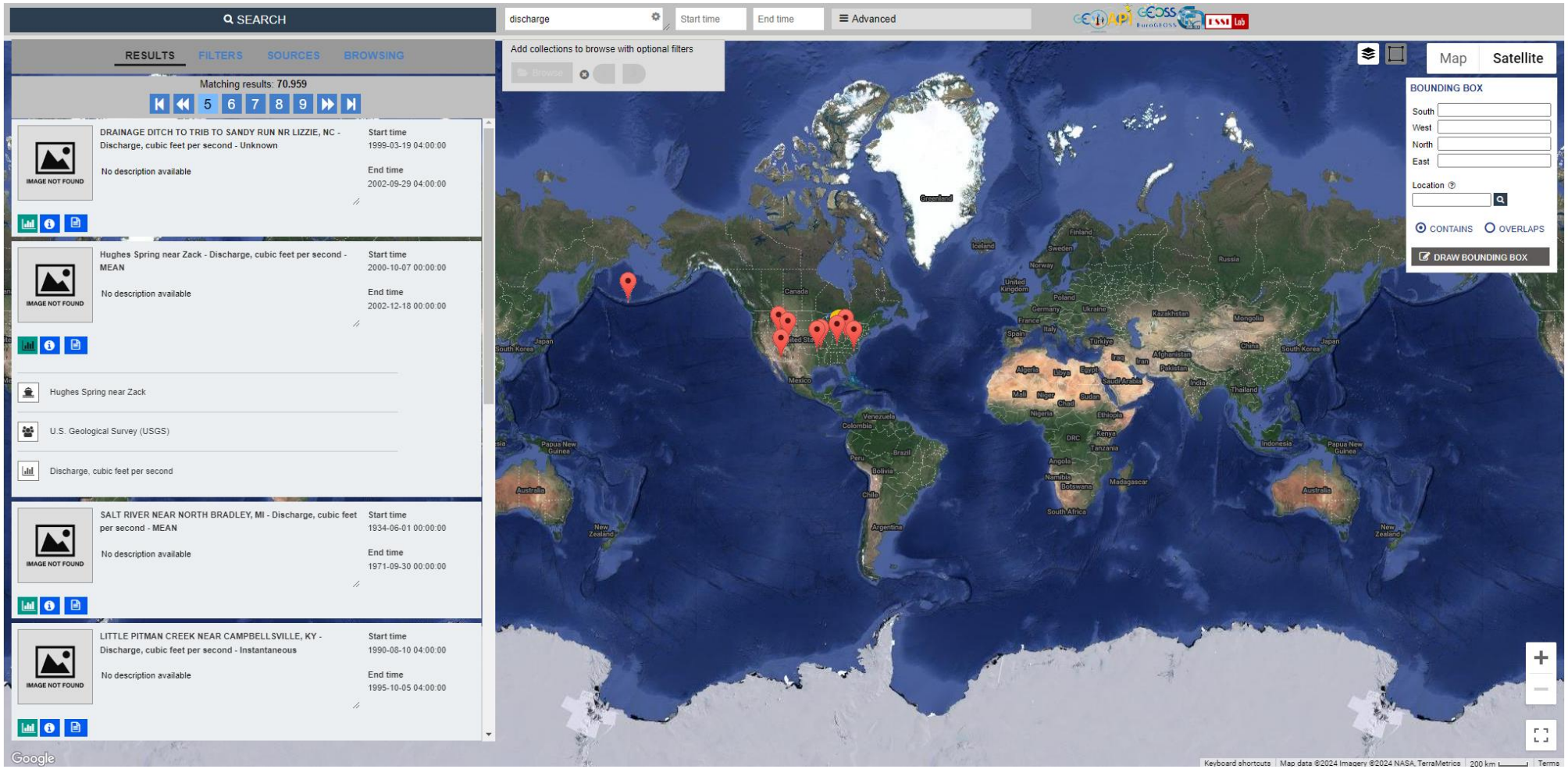
- **>100 public services**
- **>32,400 variables**
- **>2.79 million sites**
- **>33.9 million series**
- **>Referencing 18 billion data values**
- **>15,500+ download requests per day**

Available via HISCentral discovery services

Available via GetValues requests

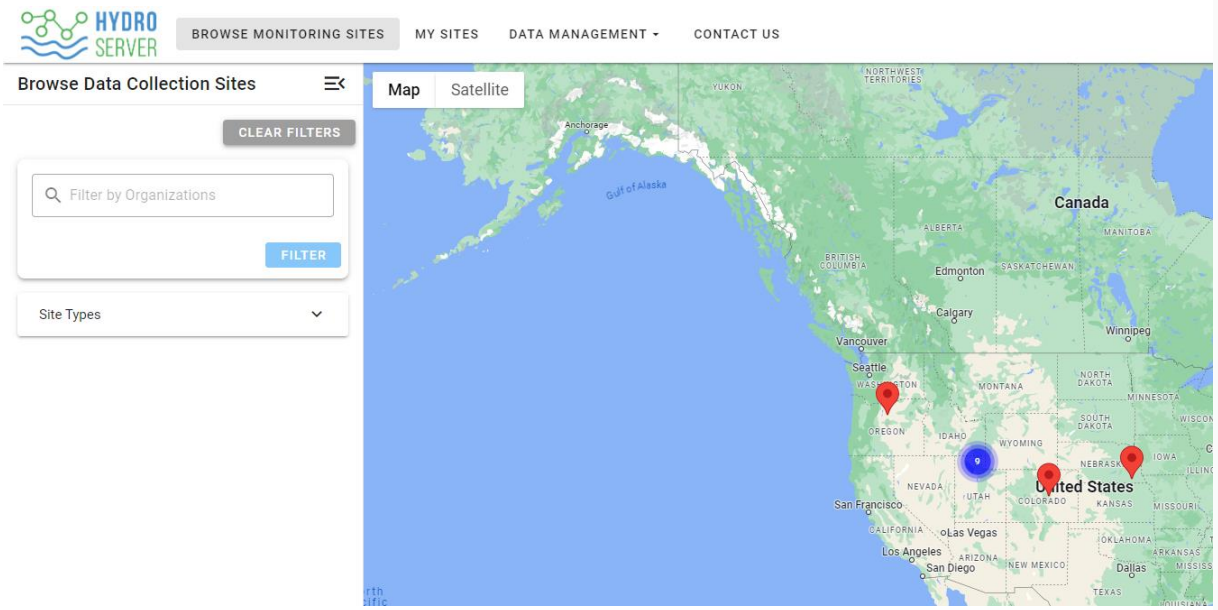
Integration results in the GI-portal

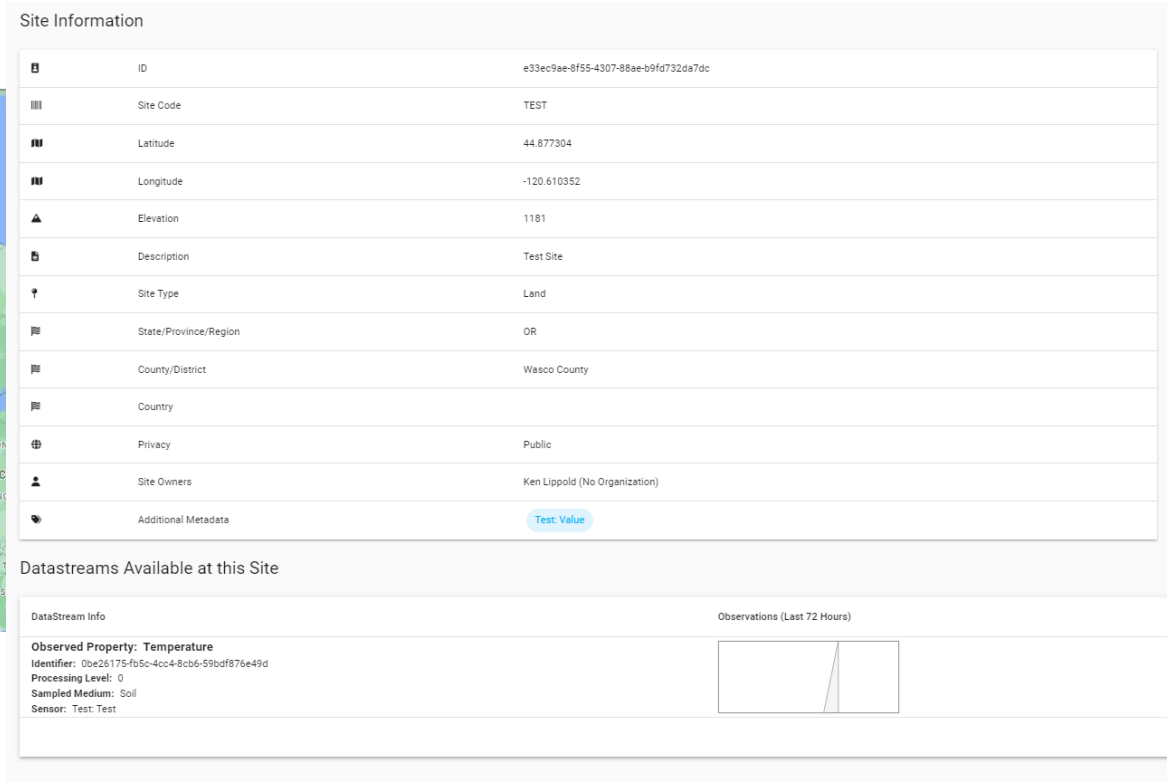
https://whos.geodab.eu/gs-service/search?view=cuahsi&token=...



CUAHSI HydroServer 2

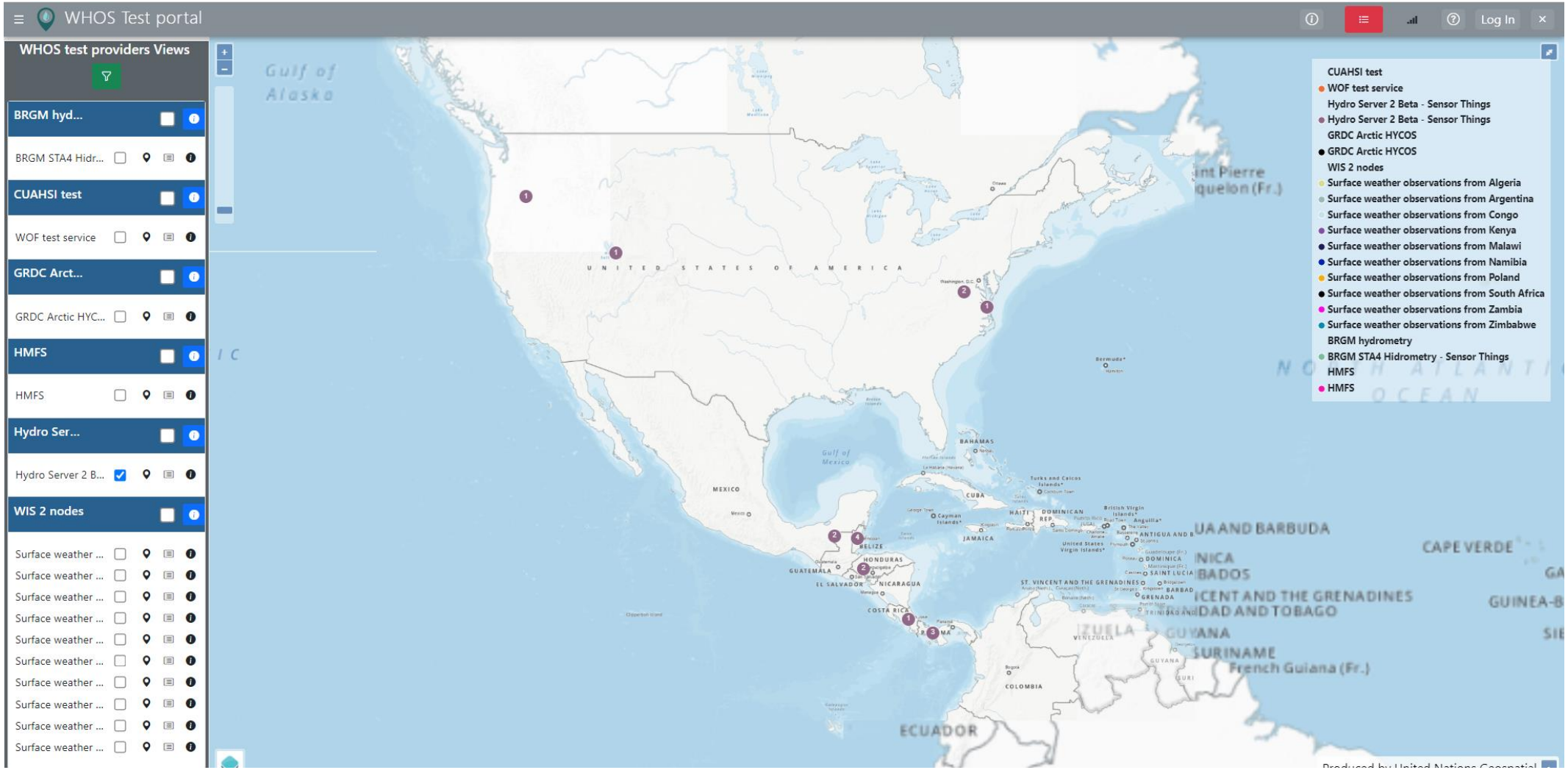
Based on OGC SensorThings API





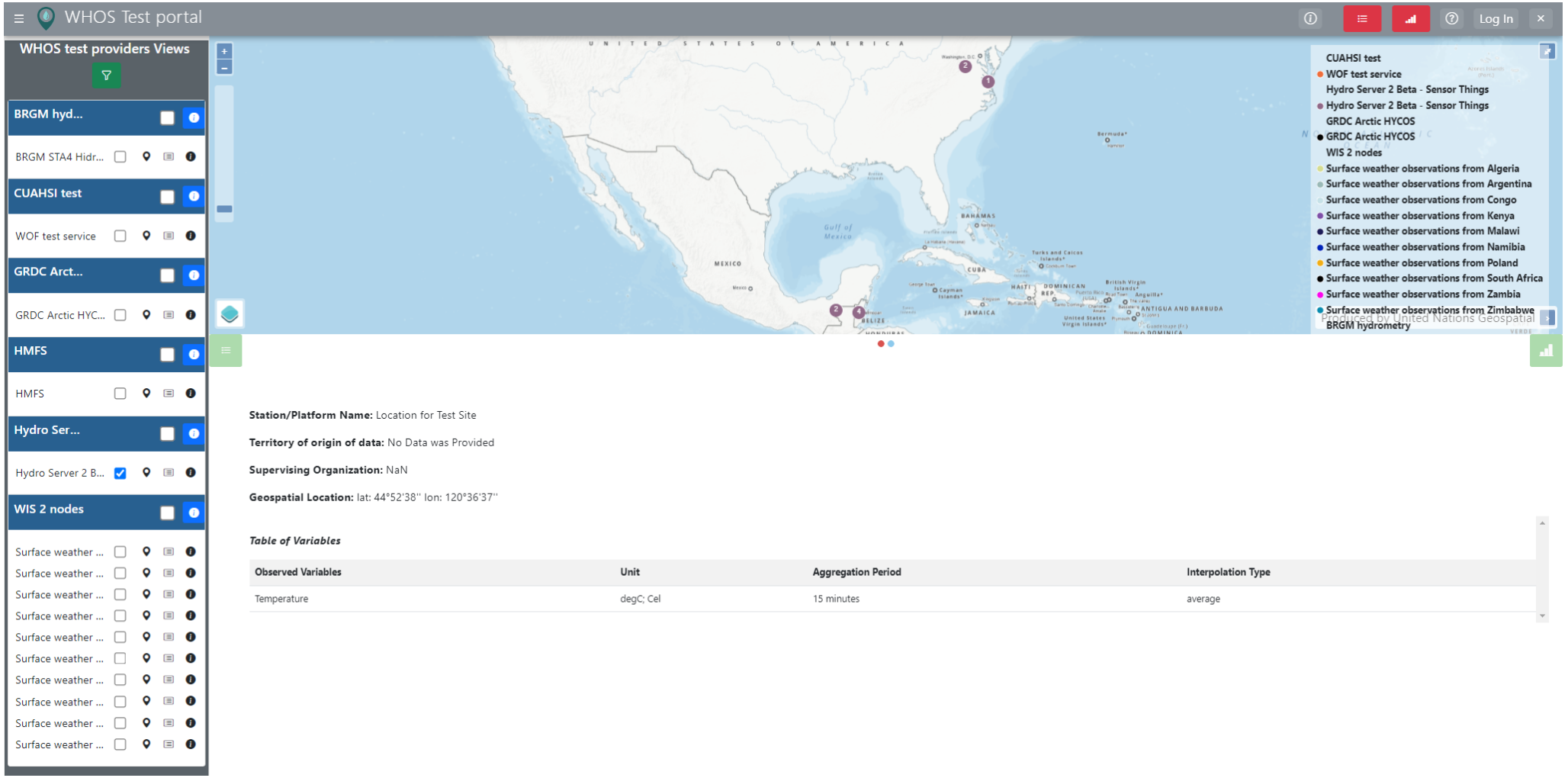
https://beta.hydroserver2.org/

Integration results in the WHOS test portal

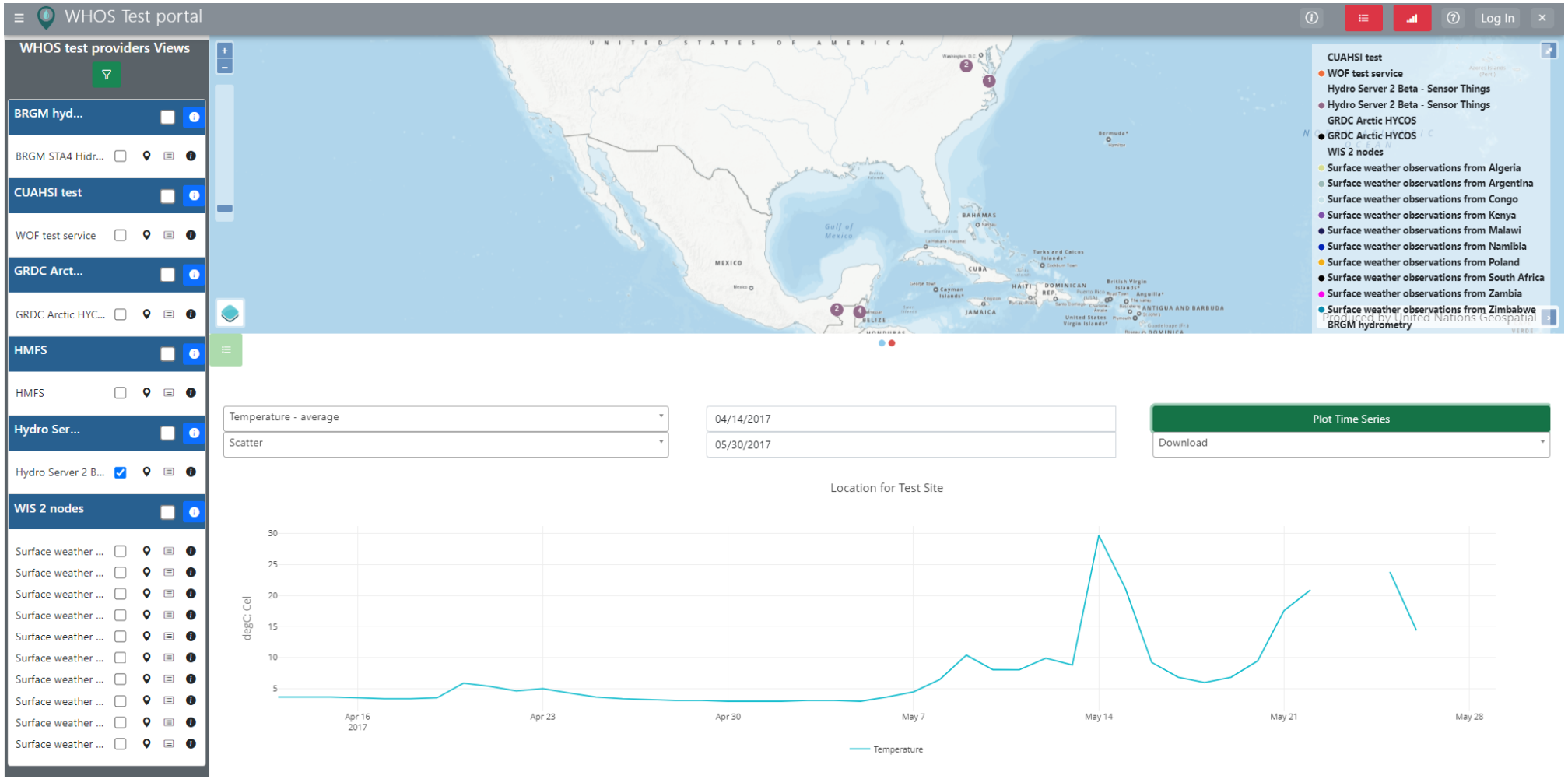


https://testwde.hydro.geodab.eu/apps/water-data-explorer-whos/

Integration results in the WHOS test portal

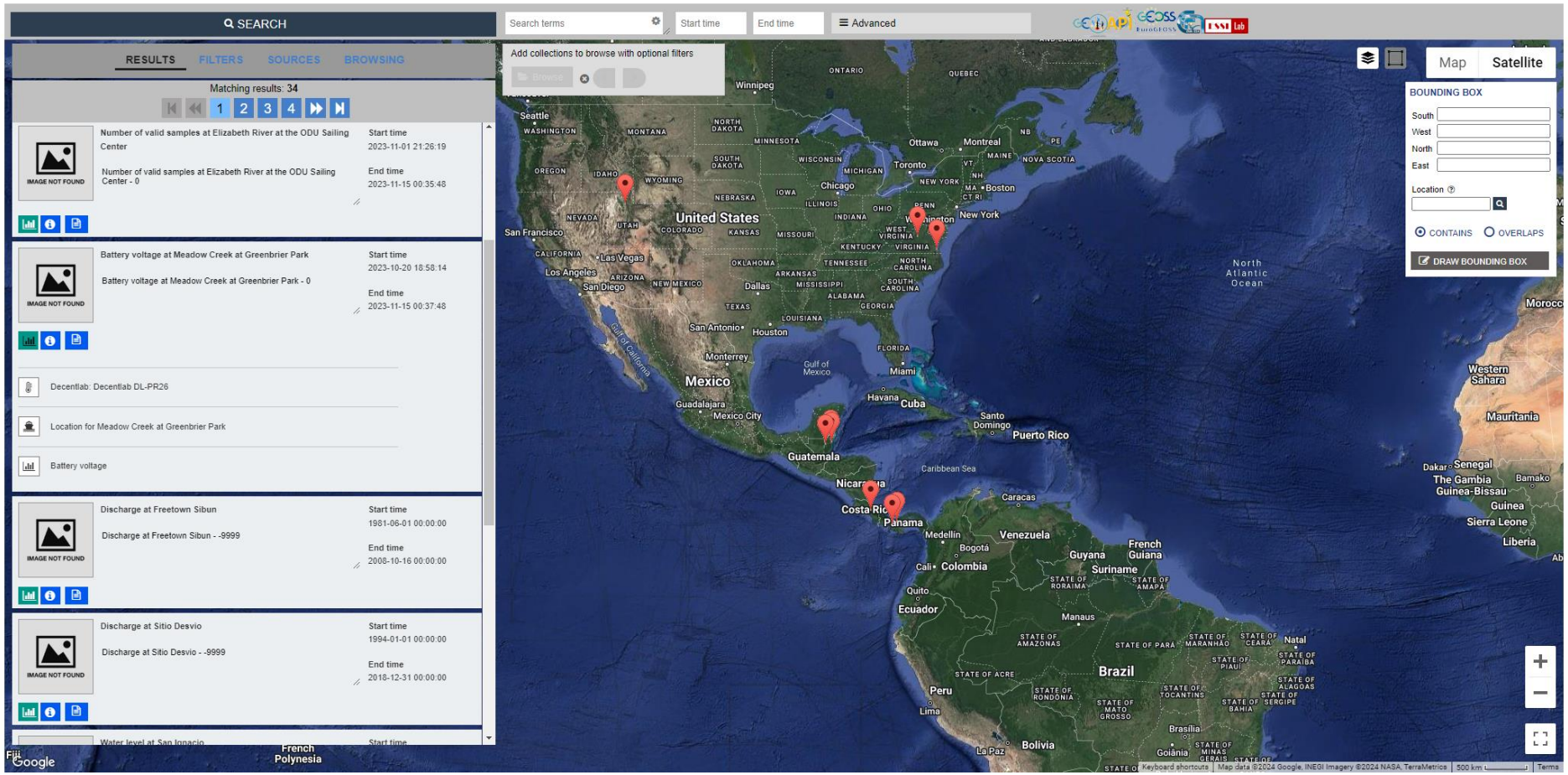


Integration results in the WHOS test portal

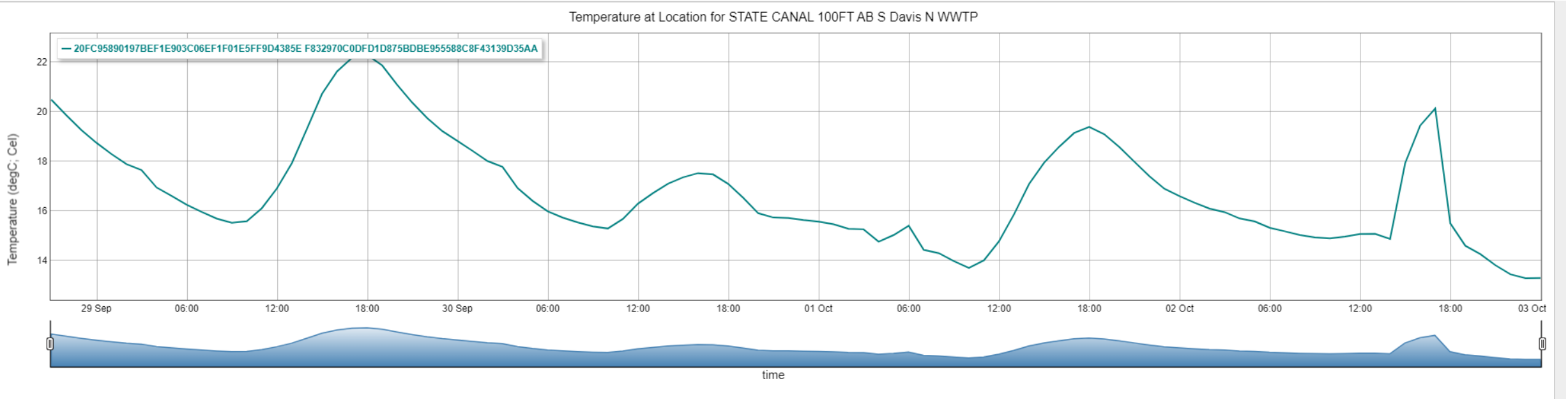


Integration results in the GI-portal

- https://whos.geodab.eu/gs-service/search?view=whos-sensorthingshydro2&token=...



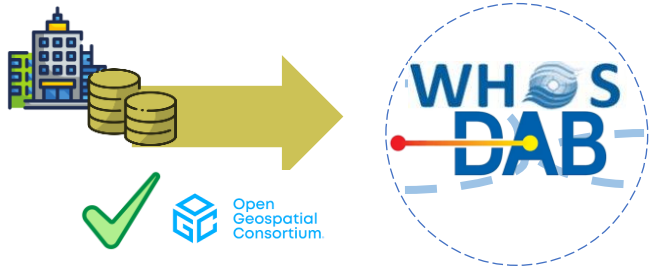
Integration results in the GI-portal



Some preliminary results on BRGM service

- Endpoint URL: https://sta4hydrometry.brgm-rec.fr/FROST-Server/

Being based on a **standard communication protocol**, it was very easy to test and integrate to WHOS in the way to the workshop!



Description of the service and some suggestions are reported after preliminary integration tests in the next slides, with the **aim of further improving the connection** to WHOS.

Things

HTTP GET request: https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Things


```
{
  "@iot.selfLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Things(1)",
  "@iot.id": 1,
  "name": "[Barbotteau] à Petit-Bourg - Barbotteau",
  "description": "Implantation station 2m avant prise d'eau Conseil Général",
  "properties": {
    "id": "https://iddata.eaufrance.fr/id/HydroStation/1011000101",
    "Commune": {
      "@type": "http://data.ign.fr/def/geofla#commune",
      "@id": "http://id.insee.fr/geo/commune/97118"
    },
    "relatedTo": [
      {
        "href": "http://iddata.eaufrance.fr/id/watershed/1011",
        "title": "Watershed"
      }
    ]
  },
  "Locations@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v
  "HistoricalLocations@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROS
  "Datastreams@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server
```


Metadata elements

- Name
- Description
- Id
- Municipality
- Related concept

Some missing elements to consider

- Contacts and responsible party, for example detailed in:
  - Responsible organization name
  - Responsible organization role
  - Responsible organization e-mail
- A datestamp could be put in the properties, to indicate the last udpate of the object(s) metadata

Locations

https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Locations


```
{
    "@iot.selfLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Locations(1)",
    "@iot.id": 1,
    "name": "[Barbotteau] à Petit-Bourg - Barbotteau",
    "description": "[Barbotteau] à Petit-Bourg - Barbotteau",
    "encodingType": "application/vnd.geo+json",
    "location": {
        "type": "Point",
        "coordinates": [
            -61.658989597,
            16.189402472
        ]
    },
    "HistoricalLocations@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Serve
    "Things@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Locati
},
```


Metadata elements

- Name
- Description
- Encoding type
- Location type (e.g., Point)
- Latitude
- Longitude

Some missing elements to consider

- Country information, expressed for example with ISO country codes (two or three digits), such as it, us, fr, etc.
- Elevation, expressed in metres

Sensors

HTTP GET request: https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Sensors


```
{
    "@iot.selfLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Sensors(1)",
    "@iot.id": 1,
    "name": "Hydrometry depth measurement by electronic probe",
    "description": "Hydrometry depth measurement by electronic probe",
    "encodingType": "http://www.opengis.net/doc/IS/SensorML/2.0",
    "metadata": "http://id.eaufrance.fr/nsa/519#2",
    "Datastreams@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Sensors(1)/Datastreams"
},
```


Metadata elements:

- Sensor name
- Sensor description
- Sensor encoding type

Note: SensorML metadata link seems unreachable now (http://id.eaufrance.fr/nsa/519#2)

Datastreams

HTTP GET request: https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Datastreams


```
{
    "@iot.selfLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Datastreams(1)",
    "@iot.id": 1,
    "name": "Hydrometry depth at [Barbotteau] à Petit-Bourg - Barbotteau with method Hydrometry dep
    "description": "Hydrometry depth at [Barbotteau] à Petit-Bourg - Barbotteau with method Hydrome
    "observationType": "http://www.opengis.net/def/observationType/OGC-OM/2.0/OM_Measurement",
    "unitOfMeasurement": {
        "name": "millimeters",
        "symbol": "mm",
        "definition": "https://data.geoscience.fr/ncl/uom/491"
    },
    "properties": {
        "relatedTo.FeaturesOfInterest@iot.id": 1
    },
    "ObservedProperty@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Da
    "Sensor@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Datastreams
    "Thing@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Datastreams(
    "Observations@iot.navigationLink": "https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Datas
},
```


Metadata elements

- Name
- Description
- Observation type
- Uom name
- Uom symbol
- Uom definition

Some missing elements to consider

- Interpolation type (e.g., continuous, average, maximum, etc.)
- Aggregation period in ISO 8601 (e.g., P1D for daily, PT1H for hourly)
- Intended observation spacing (e.g., P1D for daily, PT1H for hourly)

Observed property

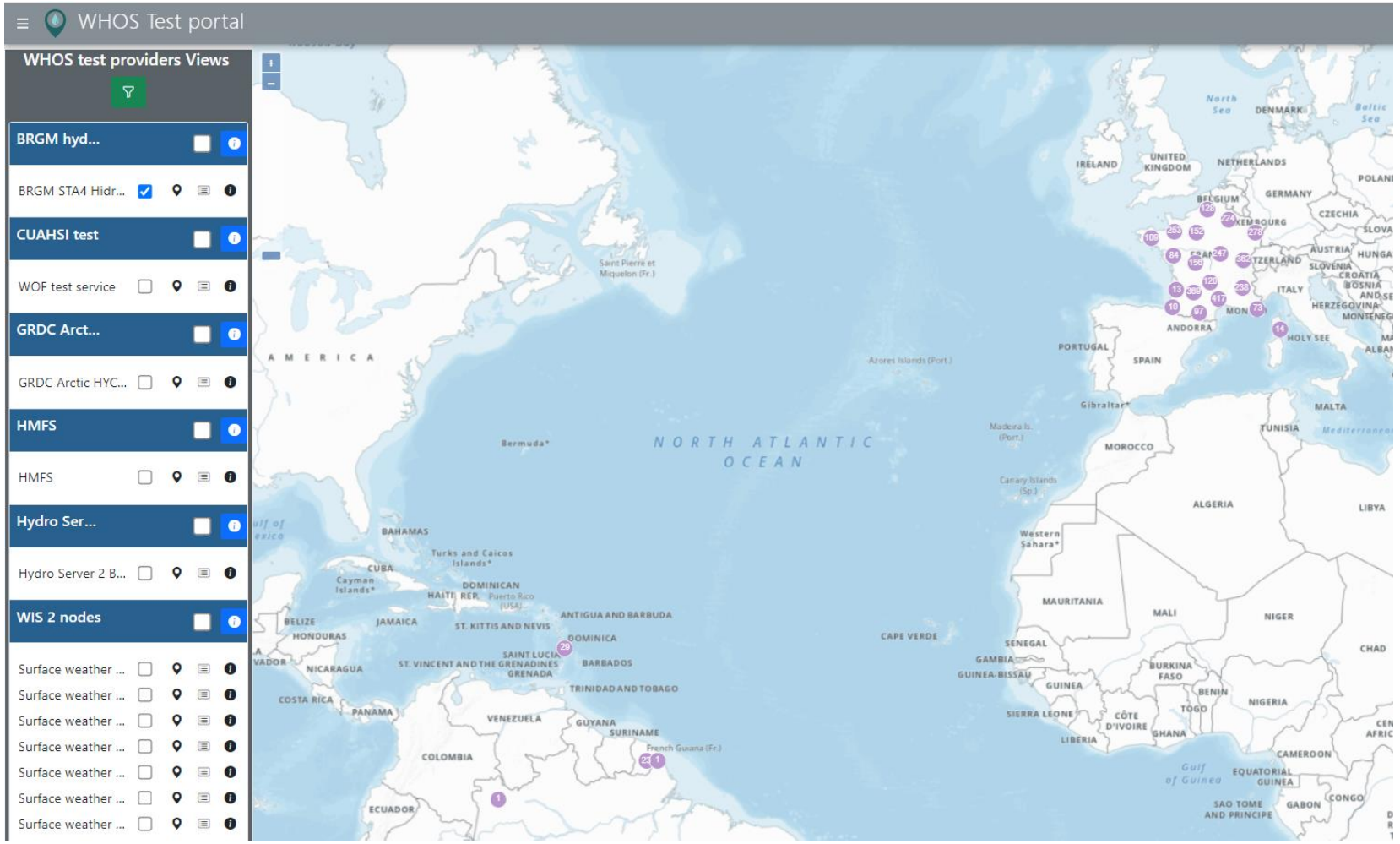
HTTP GET request: https://sta4hydrometry.brgm-rec.fr/FROST-Server/v1.1/Datastreams(1)/ObservedProperty


```
{
    "@iot.selfLink": "https://sta4hydrometry.brgm-rec.fr/FRC
    "@iot.id": 1,
    "name": "Hydrometry depth",
    "definition": "http://id.eaufrance.fr/nsa/520#H",
    "description": "Hydrometry depth",
    "Datastreams@iot.navigationLink": "https://sta4hydrometr
    Server/v1.1/ObservedProperties(1)/Datastreams"
}
```


Metadata elements

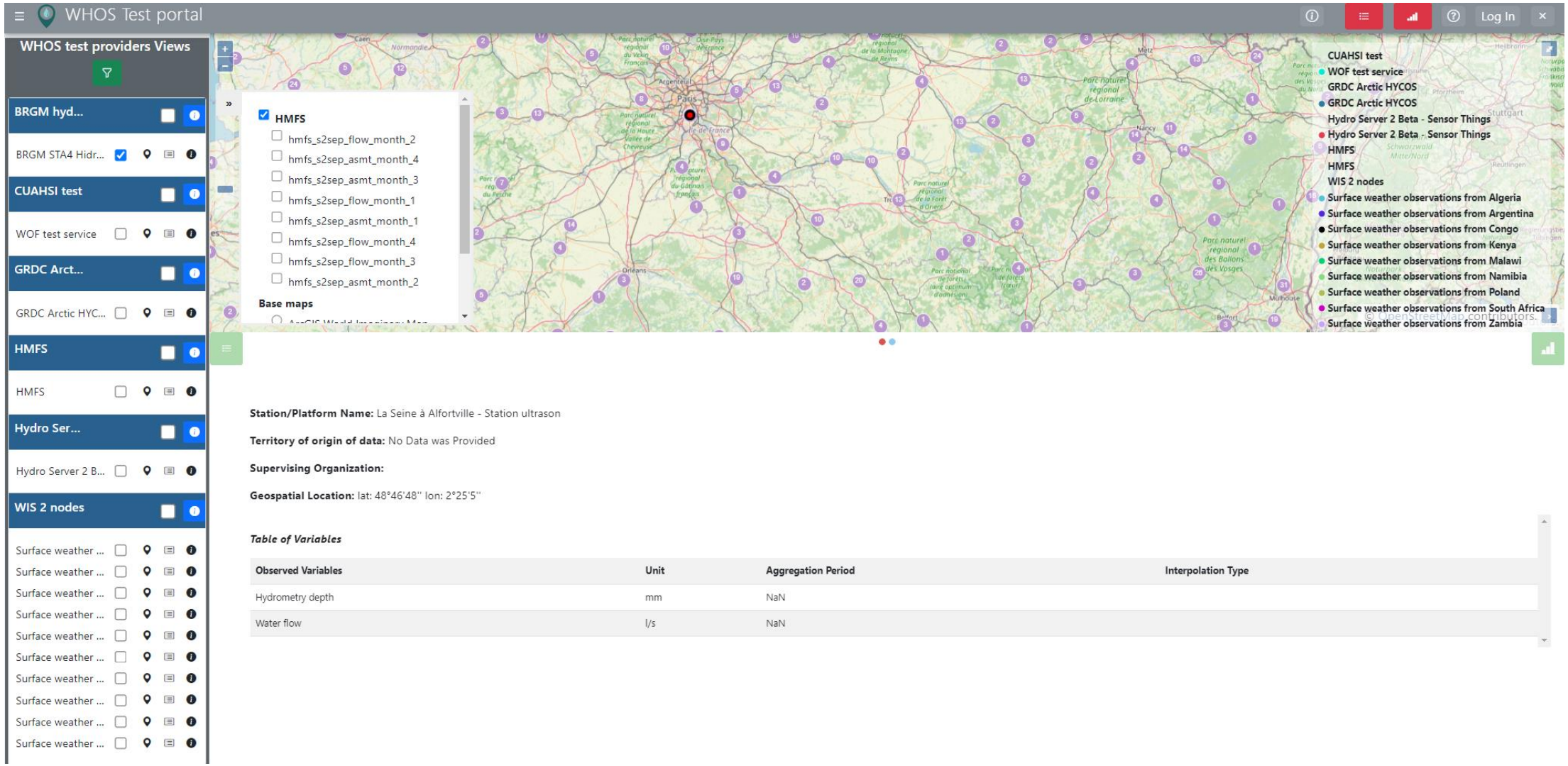
- Name
- Definition
- Description

Integration results in the WHOS test portal

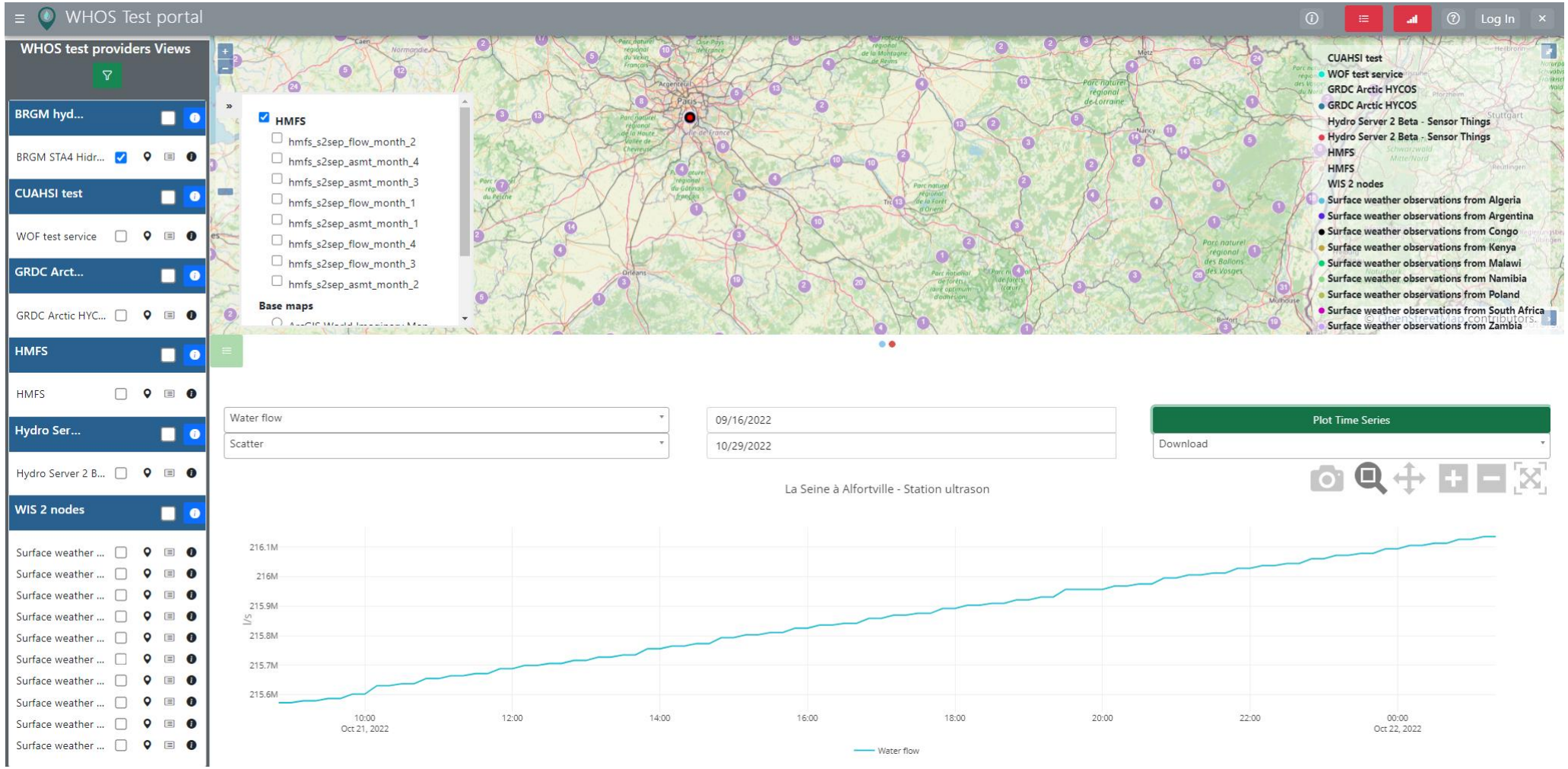


https://testwde.hydro.geodab.eu/apps/water-data-explorer-whos/

Integration results in the WHOS test portal

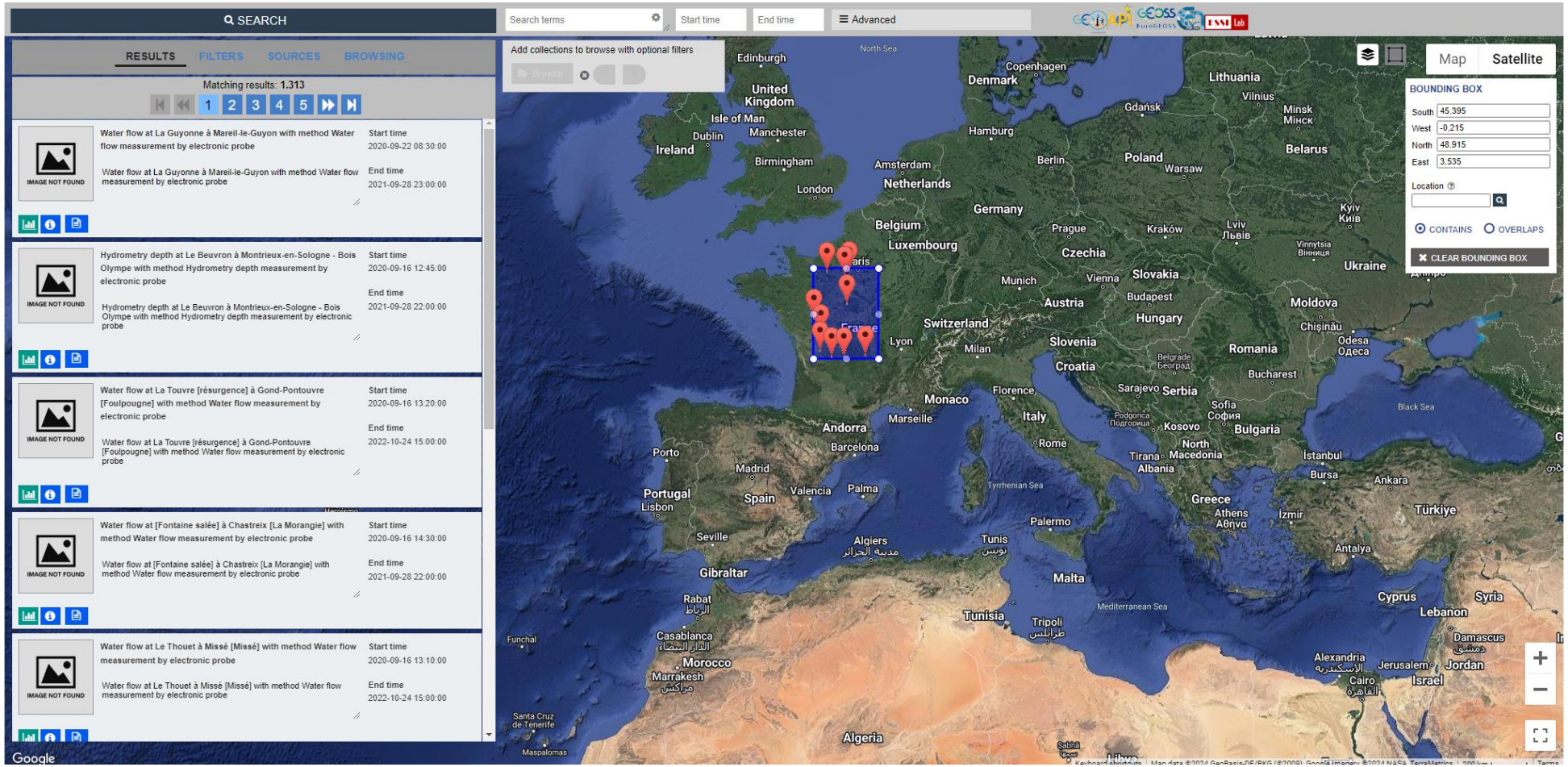


Integration results in the WHOS test portal



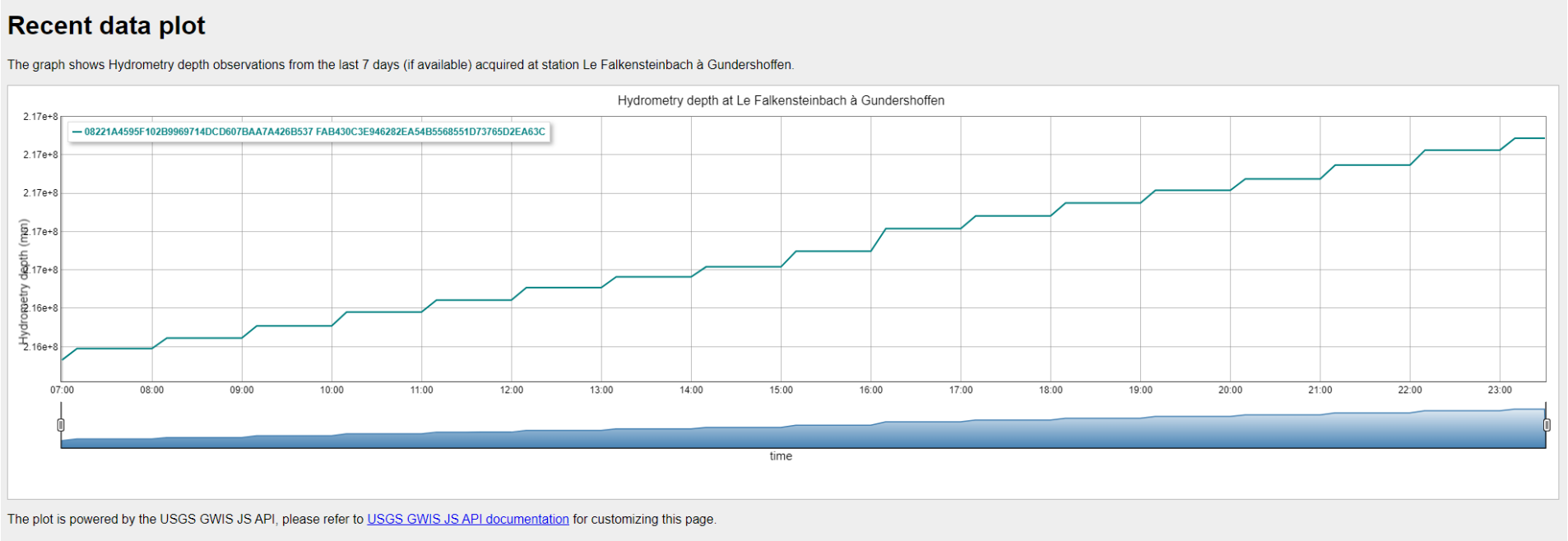
Integration results in the GI-portal

- https://whos.geodab.eu/gs-service/search?view=whos-fra-brgm-hydrometry&token=…



Integration results in the GI-portal

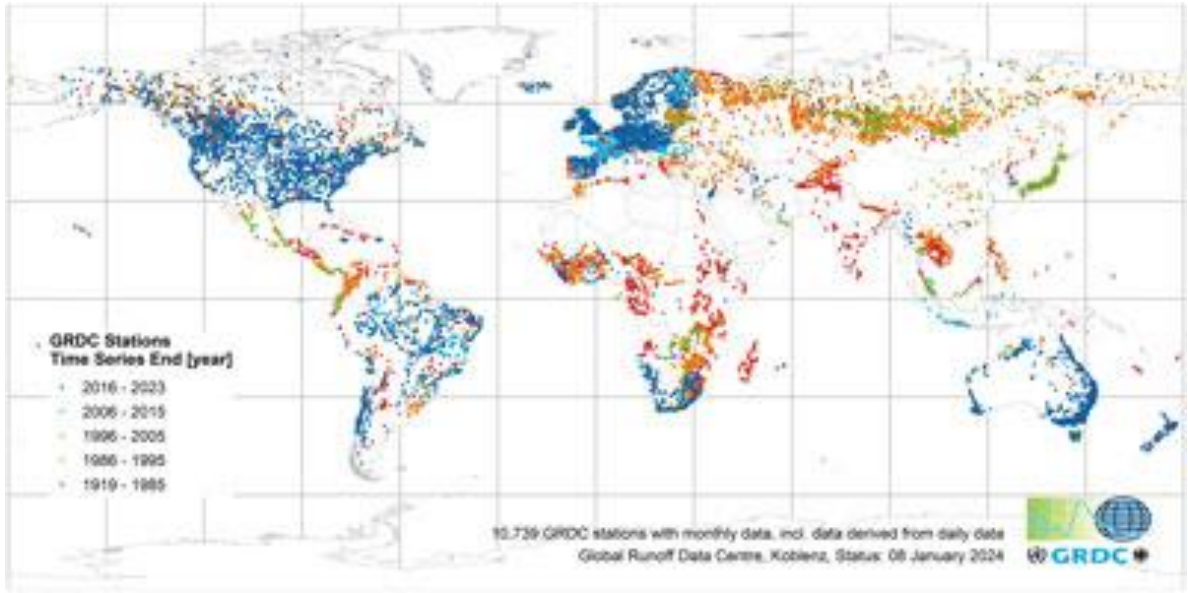
- https://whos.geodab.eu/gs-service/search?view=whos-fra-brgm-hydrometry&token=...



GRDC

GRDC

- OGC SOS v.2.0
- Global run-off data center
- Historical data



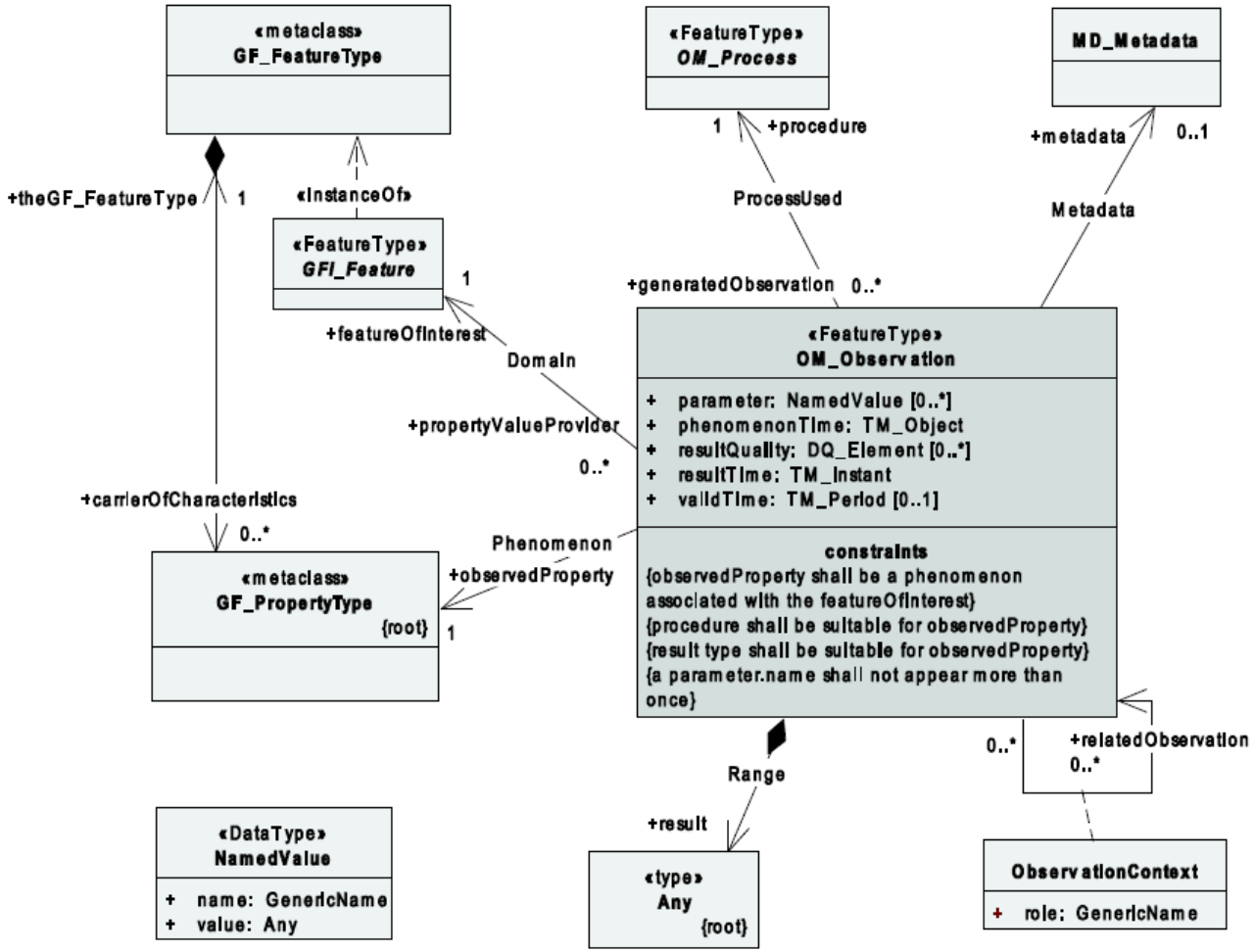
Service endpoint URL: https://portal.grdc.bafg.de/KiWIS/KiWIS?datasource=1

SOS Goal

To provide **access to observations from sensors and sensor systems in a standard way** that is consistent for all sensor systems including:

- **Remote** sensors (e.g. satellite acquisitions)
- In situ **fixed** sensors (e.g. meteorological station)
- In situ **mobile** sensors (e.g. sea glider)

Observations and measurements



An **observation** is an action whose result is an estimate of the value of some **properties** of the **feature of interest**, obtained using a specified **procedure**.

Observation Offerings

Observation Offerings are collections of observations produced by one **procedure** (e.g. **sensor + algorithm**)

Observation Offering for:
Precipitation - Cumulative

Observation Offering for:
Temperature - Maximum

MAX

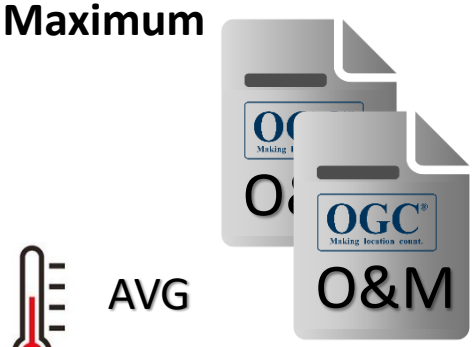
Observation Offering for:
Temperature - Average

AVG

Observation Offering for:
Precipitation - Cumulative

MAX

Observation Offering for:
Temperature - Maximum



AVG

Observation Offering for:
Temperature - Average

SOS web interface

GetCapabilities

MAX
AVG

DescribeSensor

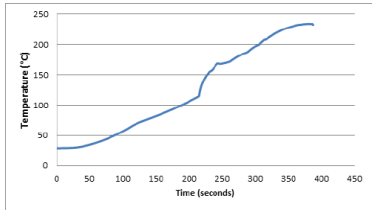
SensorML procedure description

GetFeatureOfInterest

Brasilia São Paulo Salvador

InsertObservation

GetObservation



Time series range of observations

GetDataAvailability

Observation Availability

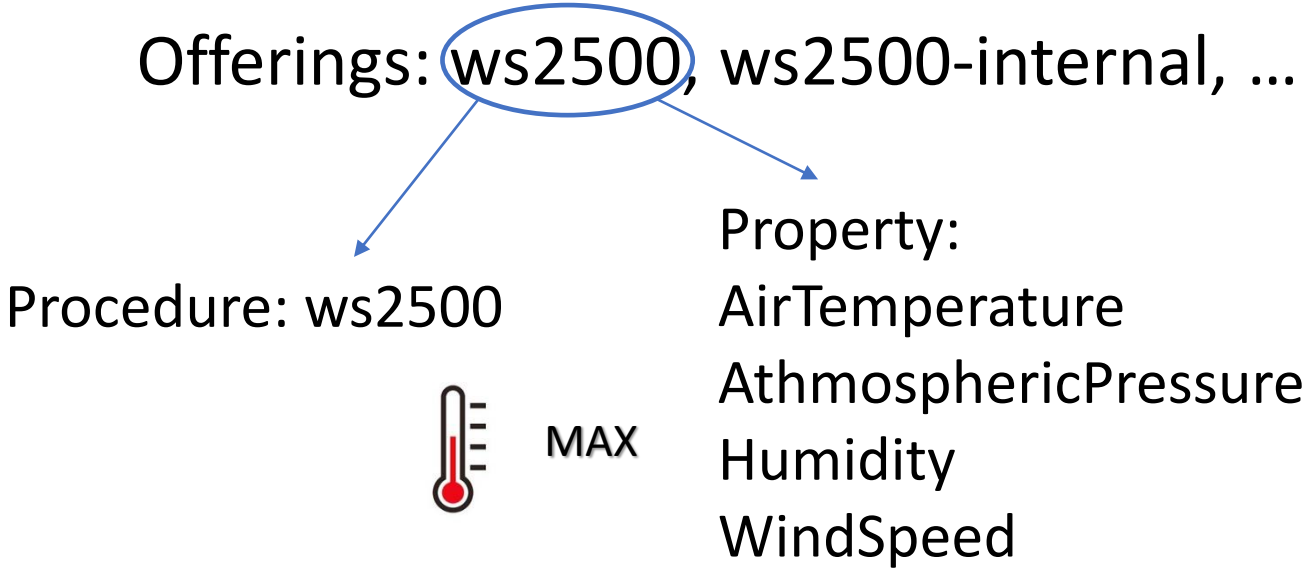
Interval given:

- property
- procedure
- feature
- offering

Value
Count

SOS HTTP-GET sample requests

- GetCapabilities
- https://portal.grdc.bafg.de/KiWIS/KiWIS?datasource=1&SERVICE=SOS&VERSION=2.0.0&REQUEST=GetCapabilities



SOS HTTP-GET sample requests

- GetFeatureOfInterest

https://portal.grdc.bafg.de/KiWIS/KiWIS?datasource=1&SERVICE=SOS&VERSION=2.0.0&REQUEST=GetFeatureOfInterest&procedure=https://portal.grdc.bafg.de/tstypes/Year.Max

Feature: elv-ws2500

Name: ELV WS2500

GML Point:

51.934814453125 7.652428150177

To retrieve the list of sites

SOS HTTP-GET sample requests

- DescribeSensor

https://portal.grdc.bafg.de/KiWIS/KiWIS?datasource=1&SERVICE=SOS&VERSION=2.0.0&REQUEST=DescribeSensor&procedure=https://portal.grdc.bafg.de/tstypes/Year.Max&procedureDescriptionFormat=http://www.opengis.net/waterml/2.0/observationProcess

Deployment date:
2015-05-18T14:05:00Z

Description:
ELV WS 2500 Weather station maintained at 52N office.

Contact Info:
52°North GmbH

SOS HTTP-GET sample requests

- GetDataAvailability

https://portal.grdc.bafg.de/KiWIS/KiWIS?datasource=1&SERVICE=SOS&VERSION=2.0.0&REQUEST=GetDataAvailability&procedure=https://portal.grdc.bafg.de/tstypes/Year.Max&featureOfInterest=https://portal.grdc.bafg.de/stations/2999910

Begin time position:
2018-03-01T00:30:00.000Z

End time position:
2018-03-28T23:45:00.000Z

SOS HTTP-GET sample requests

- GetObservation

https://portal.grdc.bafg.de/KiWIS/KiWIS?datasource=1&SERVICE=SOS&VERSION=2.0.0&REQUEST=GetObservation&procedure=https://portal.grdc.bafg.de/tstypes/Year.Max&featureOfInterest=https://portal.grdc.bafg.de/stations/2999910&temporalFilter=om:phenomenonTime,2008-03-01T00:30:00Z/2010-03-02T11:00:00Z

2009

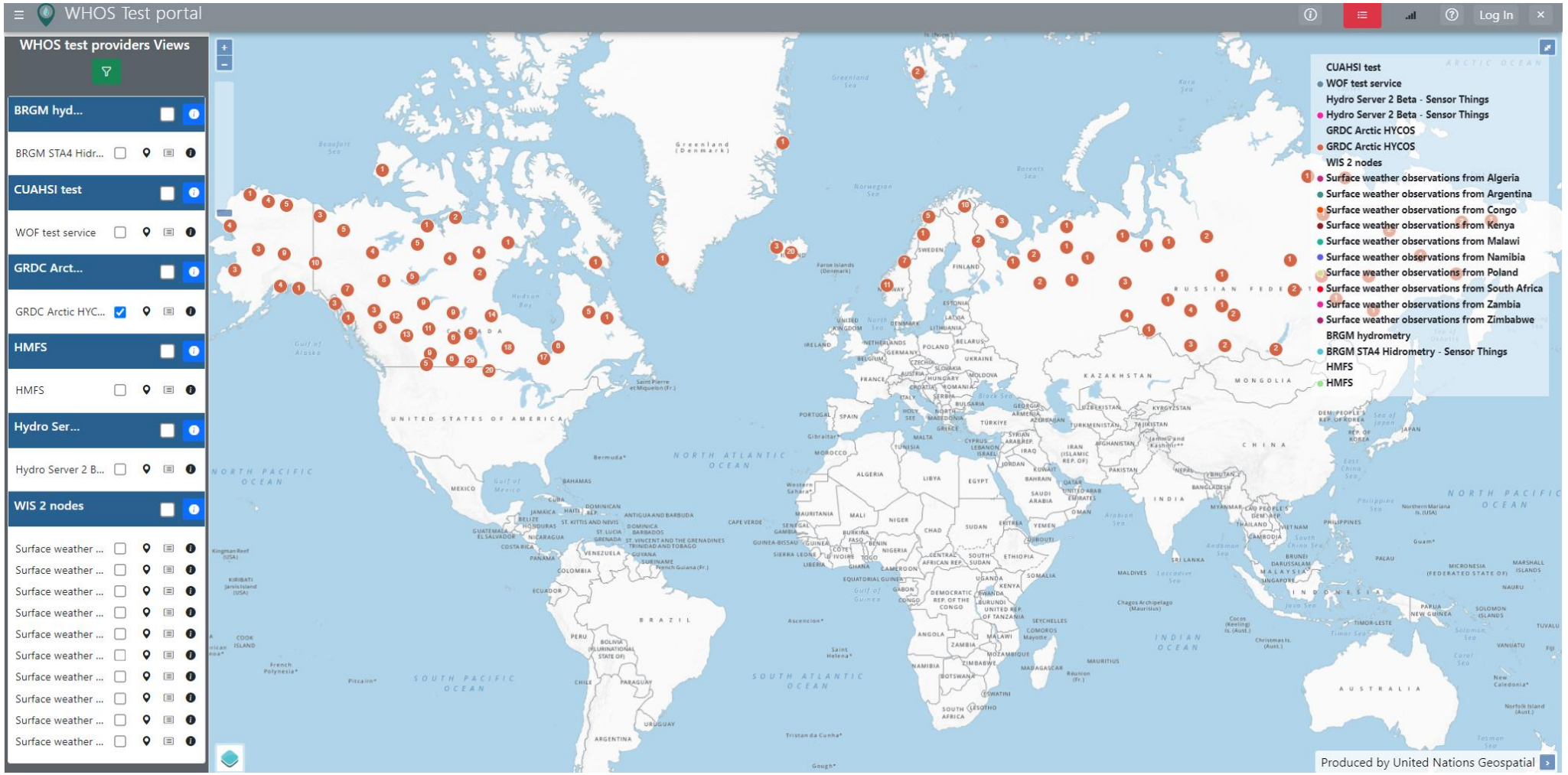
9890 m^3/s

2010

13400 m^3/s

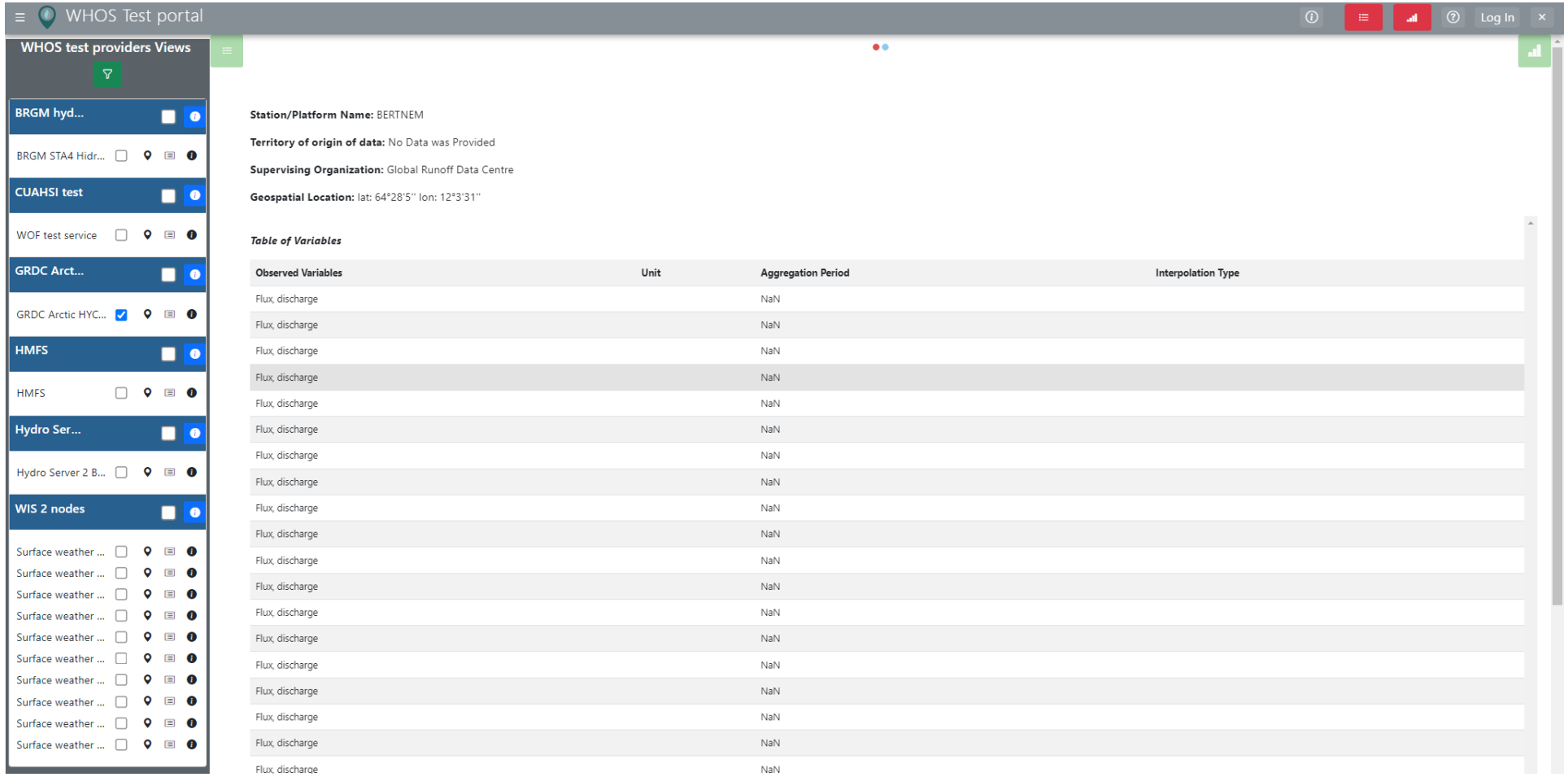
…

Integration results in the WHOS test portal



https://testwde.hydro.geodab.eu/apps/water-data-explorer-whos/

Integration results in the WHOS test portal



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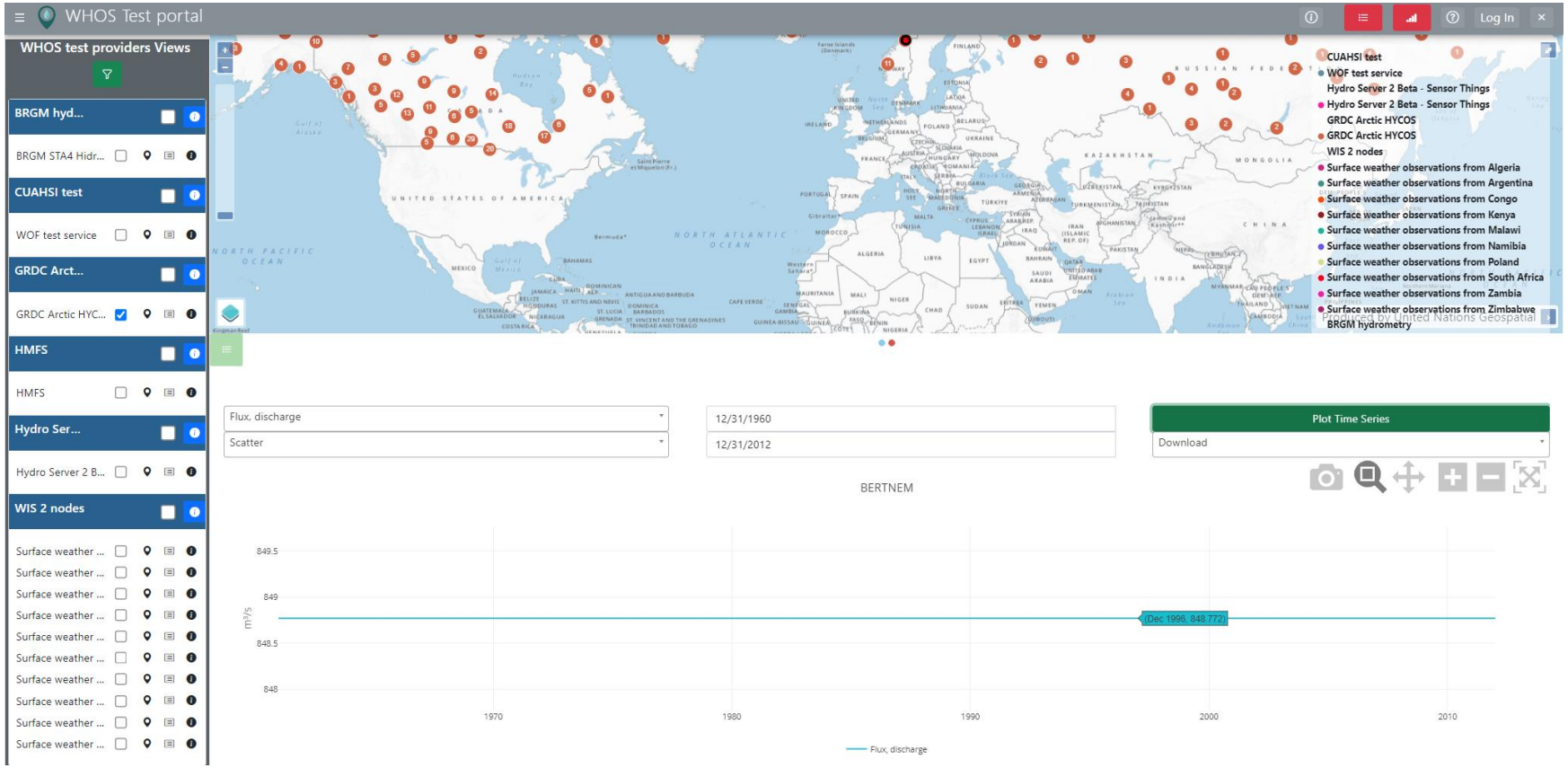
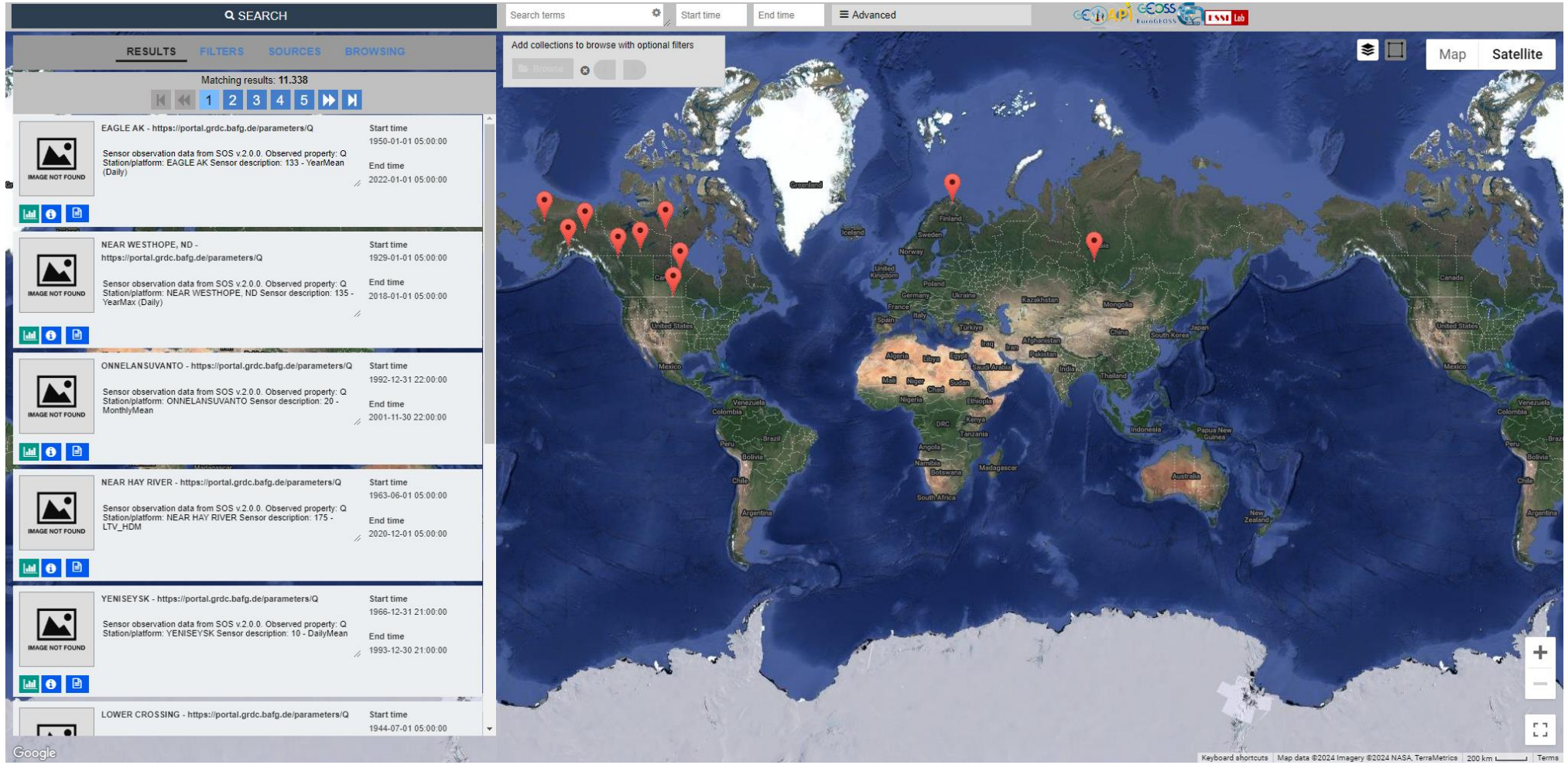
Integration results in the WHOS test portal



https://testwde.hydro.geodab.eu/apps/water-data-explorer-whos/

Integration results in the GI-portal

https://whos.geodab.eu/gs-service/search?view=grdc-arctic-hycos&token=...



VISIT WHOS Site: Link to WHOS Site

Contact Us: whos@wmo.int