GGRETA
GOVERNANCE OF GROUNDWATER RESOURCES IN TRANSBOUNDARY AQUIFERS

Online Course on Groundwater Management in African Lake and River Basin Organizations

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

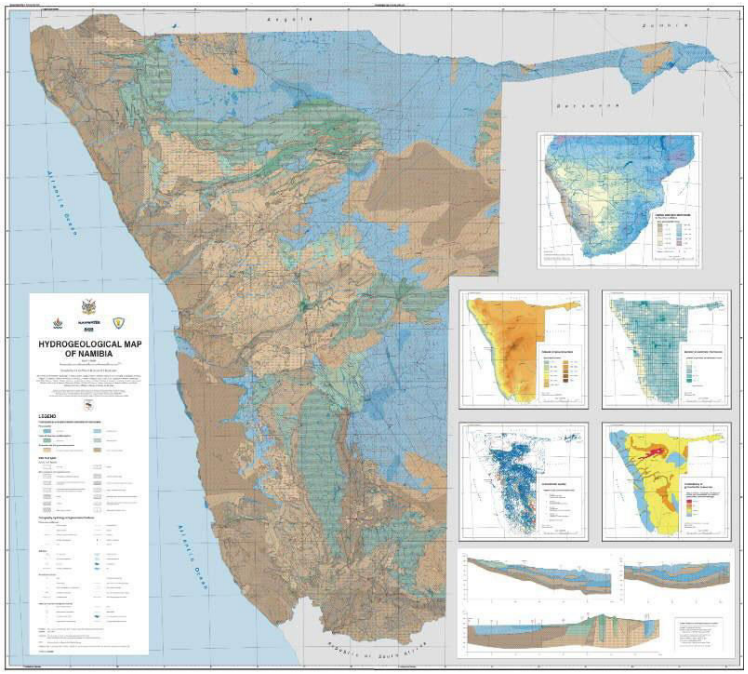
Fostering data sharing

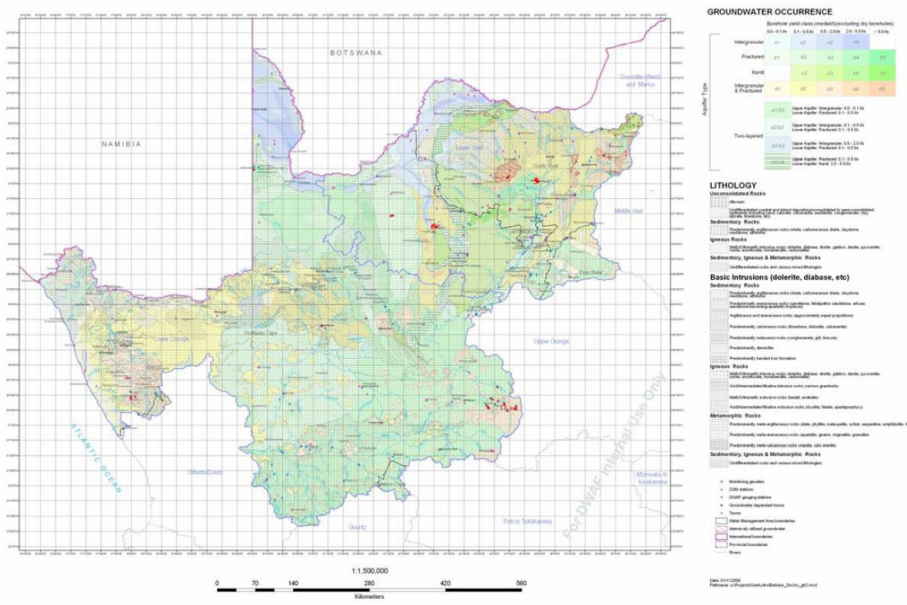
Arnaud Sterckx, IGRAC

Data vs. Information

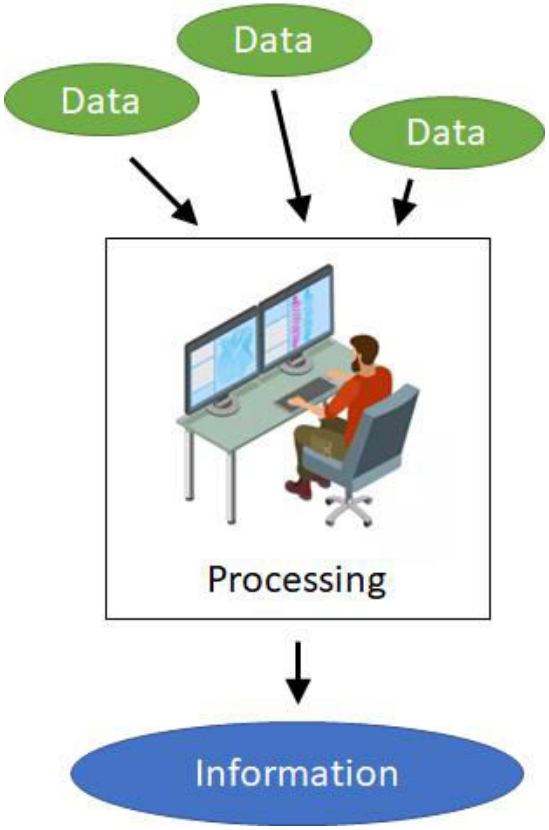
- Data are **independent of the context**. Unlike information, they are unbiased.
- **Data can be reinterpreted** for multiple purposes.

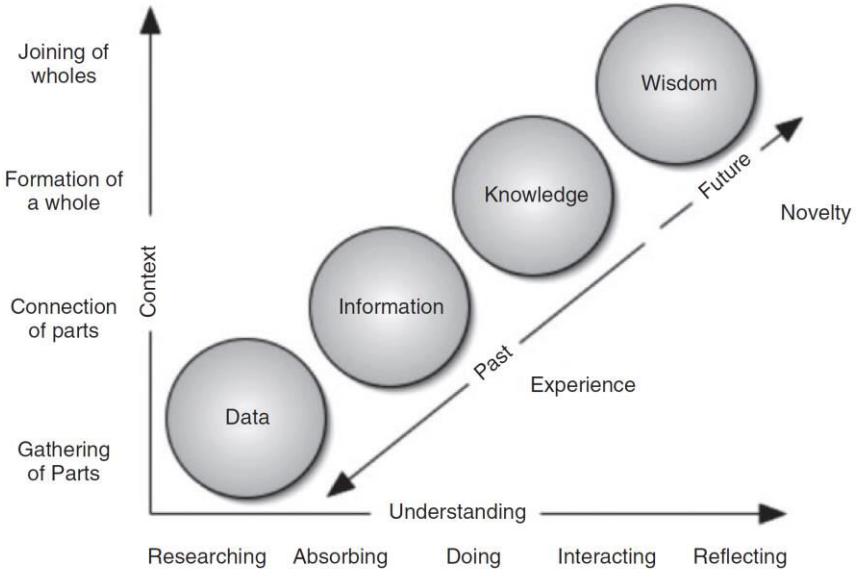
Example: How would you merge different groundwater maps into one that covers the entire basin?





Groundwater data are translated into information by hydrogeologists





Examples of groundwater information:

- *Piezometric map*
- *Graph showing groundwater level trends*
- *Report on the state of groundwater*
- *Warning on groundwater pollution*

Rio Declaration On Environment And Development (1992), article 10:

[…] At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. […]

SADC Regional Water Policy (SADC, 2005)

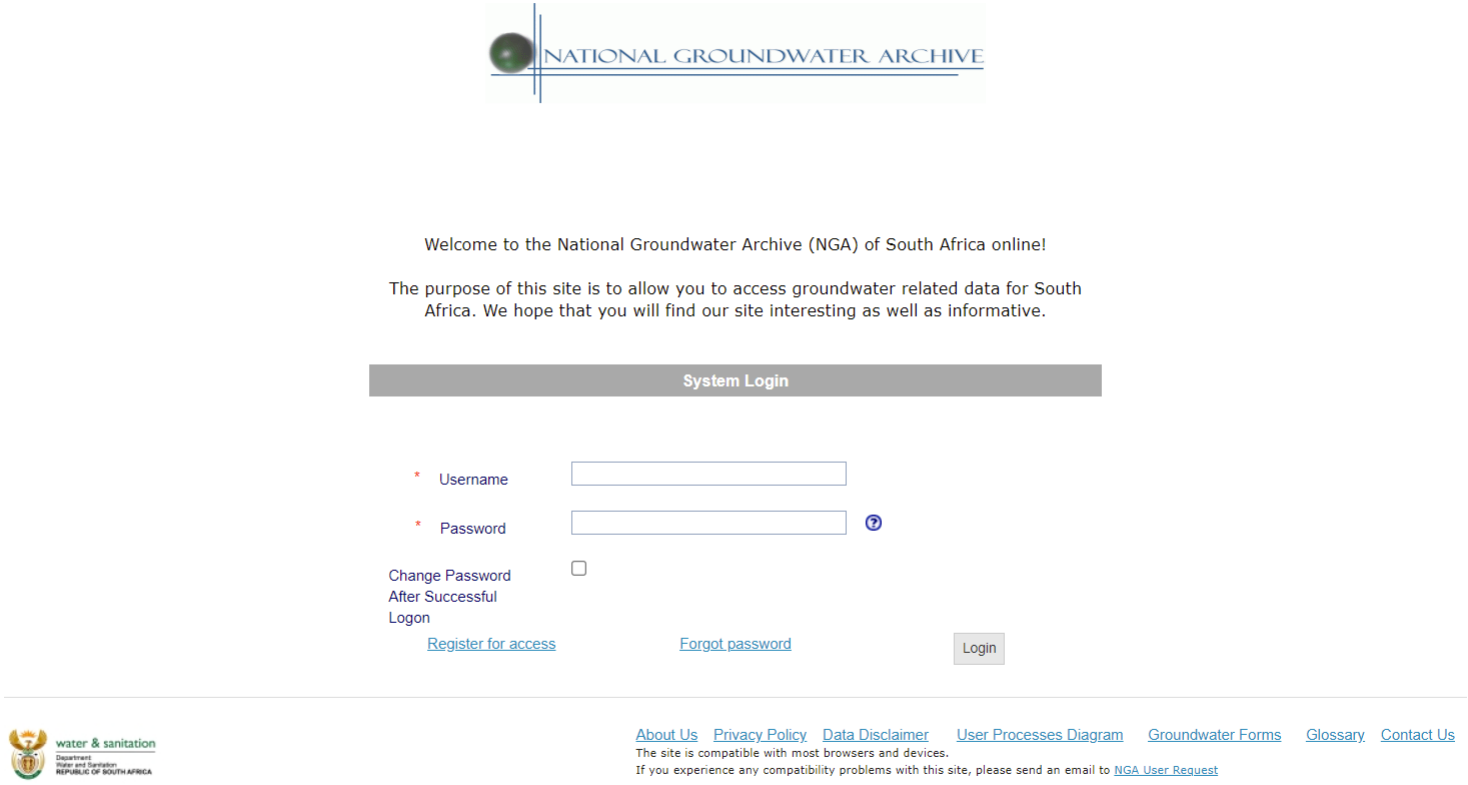
(i) Member States shall timeously share relevant available information and data regarding the hydrological, hydro-geological, water quality, meteorological and environmental condition of shared watercourses.

(ii) Member States shall ensure that members of the public in the region have access to relevant and understandable information regarding water resources impacting on their health or safety and on economic interests.

(iii) SADC, SWCIs as well as Member States shall establish mechanisms for regular interpretation and dissemination of essential information on water resources so that the public is regularly informed.

Several countries have developed online tools, platforms, dashboards, cellphone apps, etc. to share groundwater data and information.

https://www.dws.gov.za/NGANet/Security/WebLoginForm.aspx

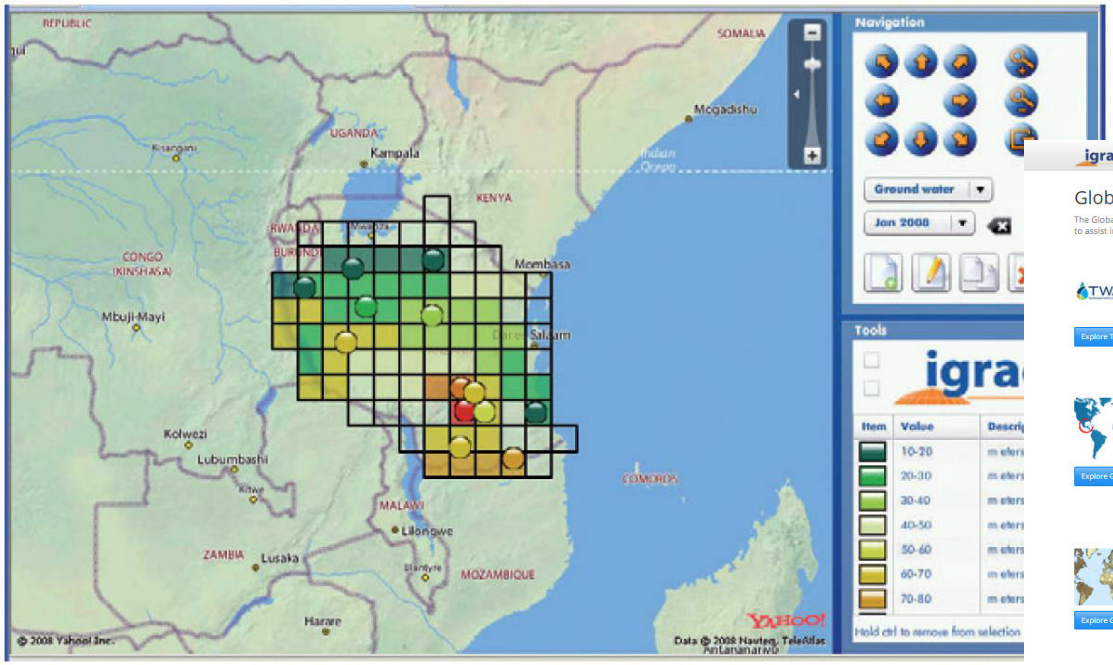


Yet, in many countries, data must be requested. Sometimes a fee is asked. Answers might come after several days. Eventually, there might be no data available. See *IGRAC and IGS (2019) State of groundwater data collection and management in SADC Member States*

Groundwater Governance (2017) a call for action: A Shared Global Vision for 2030

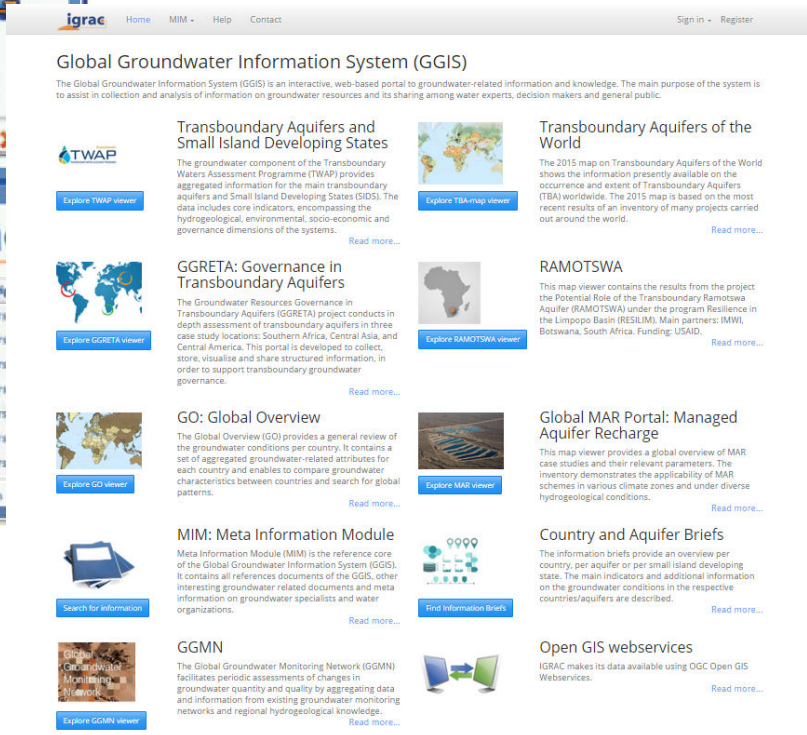
Data sharing infrastructure

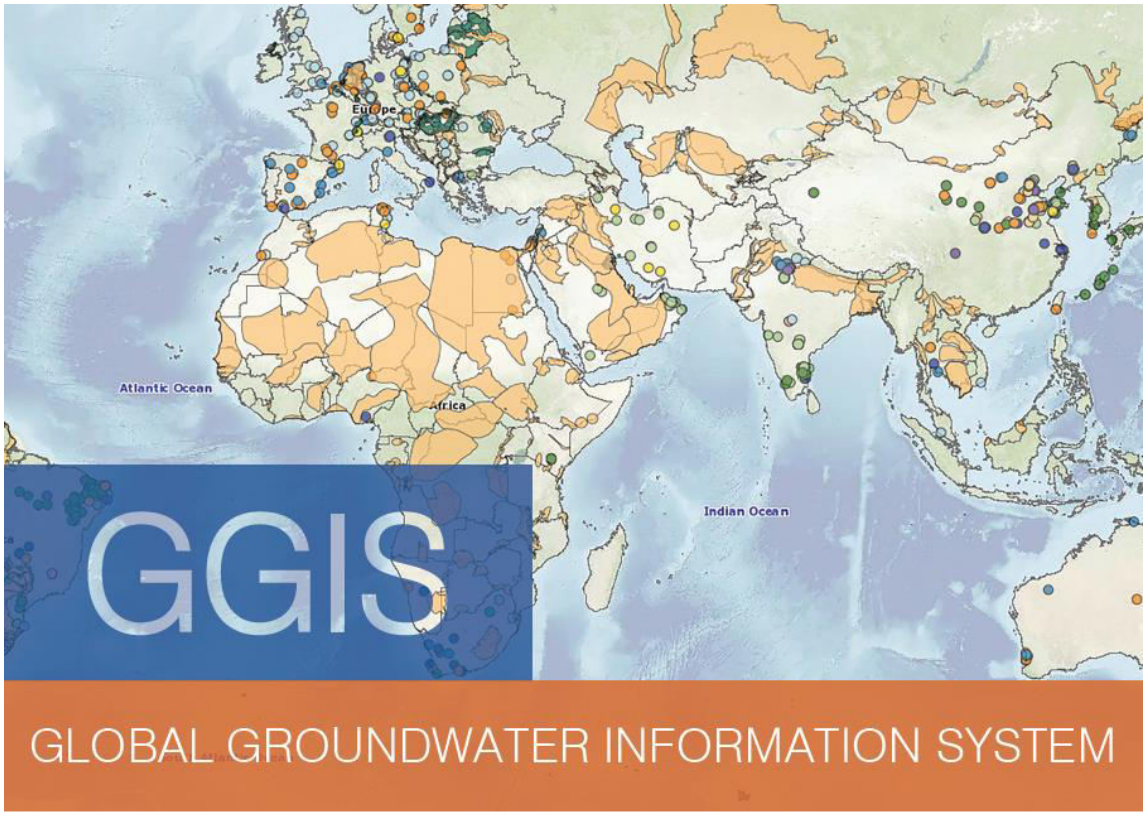
Since 2004, IGRAC promotes the sharing of groundwater data and information through the Global Groundwater Information System (GGIS) and the Global Groundwater Monitoring Network (GGMN) platform.



2008

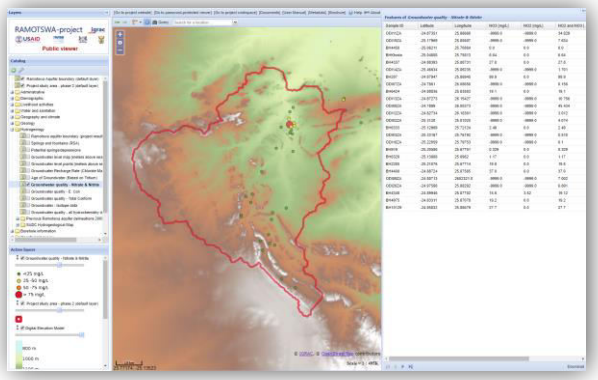
2016





SADC Groundwater Information Portal

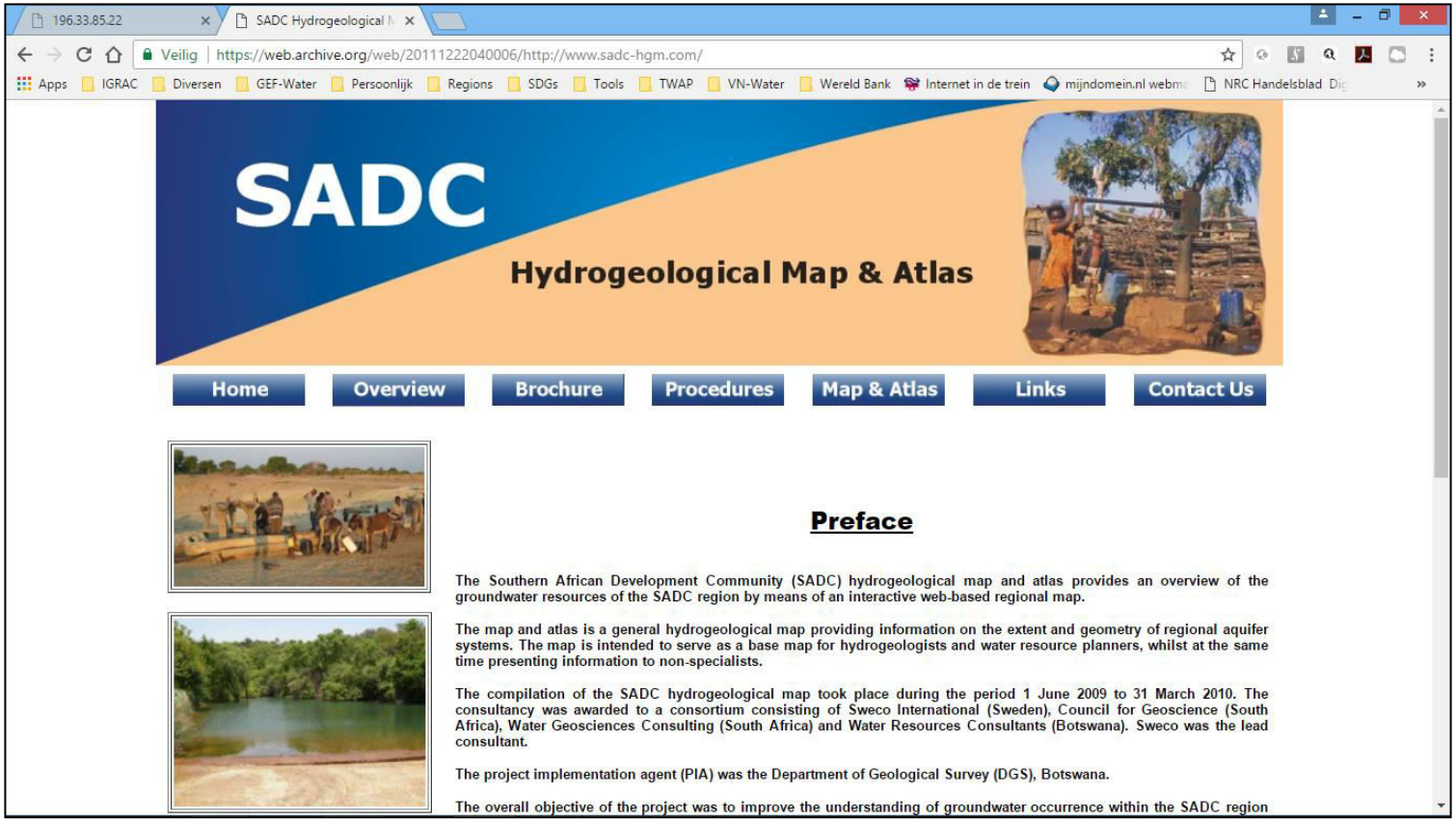
Stampriet Information Management System (GGRETA-1)



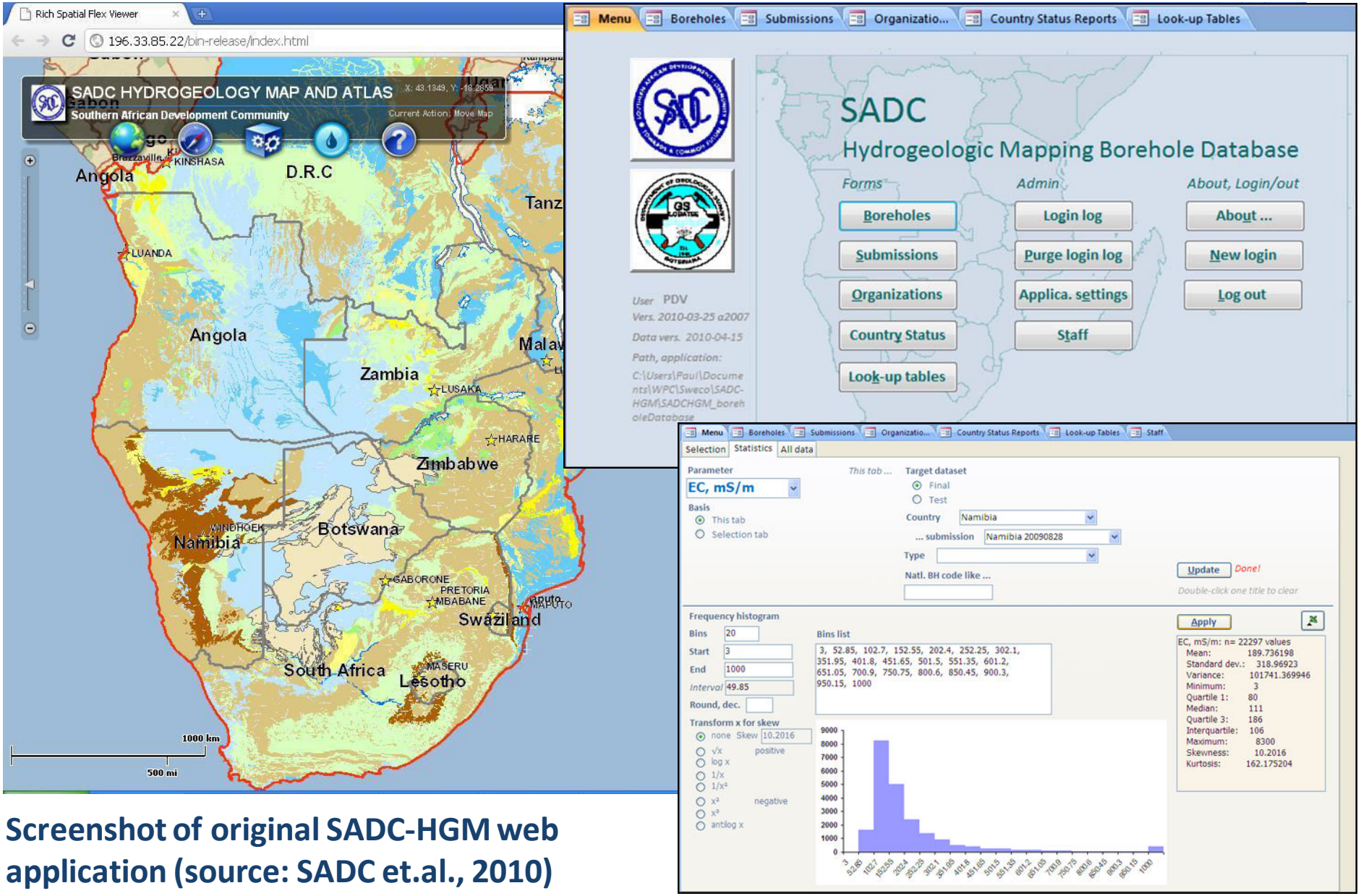
Ramotswa Information Management System

The SADC Groundwater Information Portal

2010: SADC Hydrogeological Mapping Project (SADC et.al.)

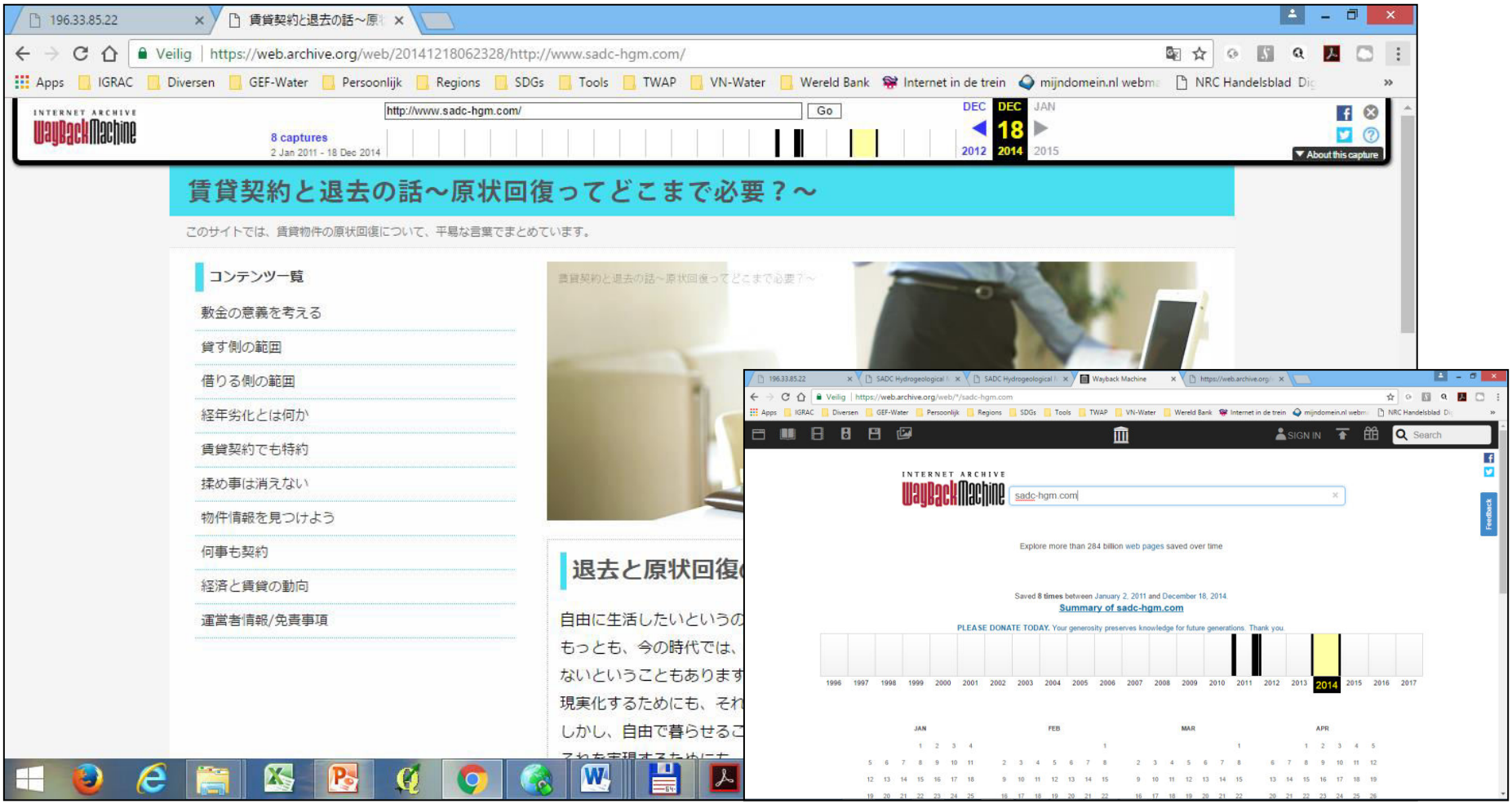


https://web.archive.org/web/20111222040006/http://www.sadc-hgm.com/
Status: January 2012



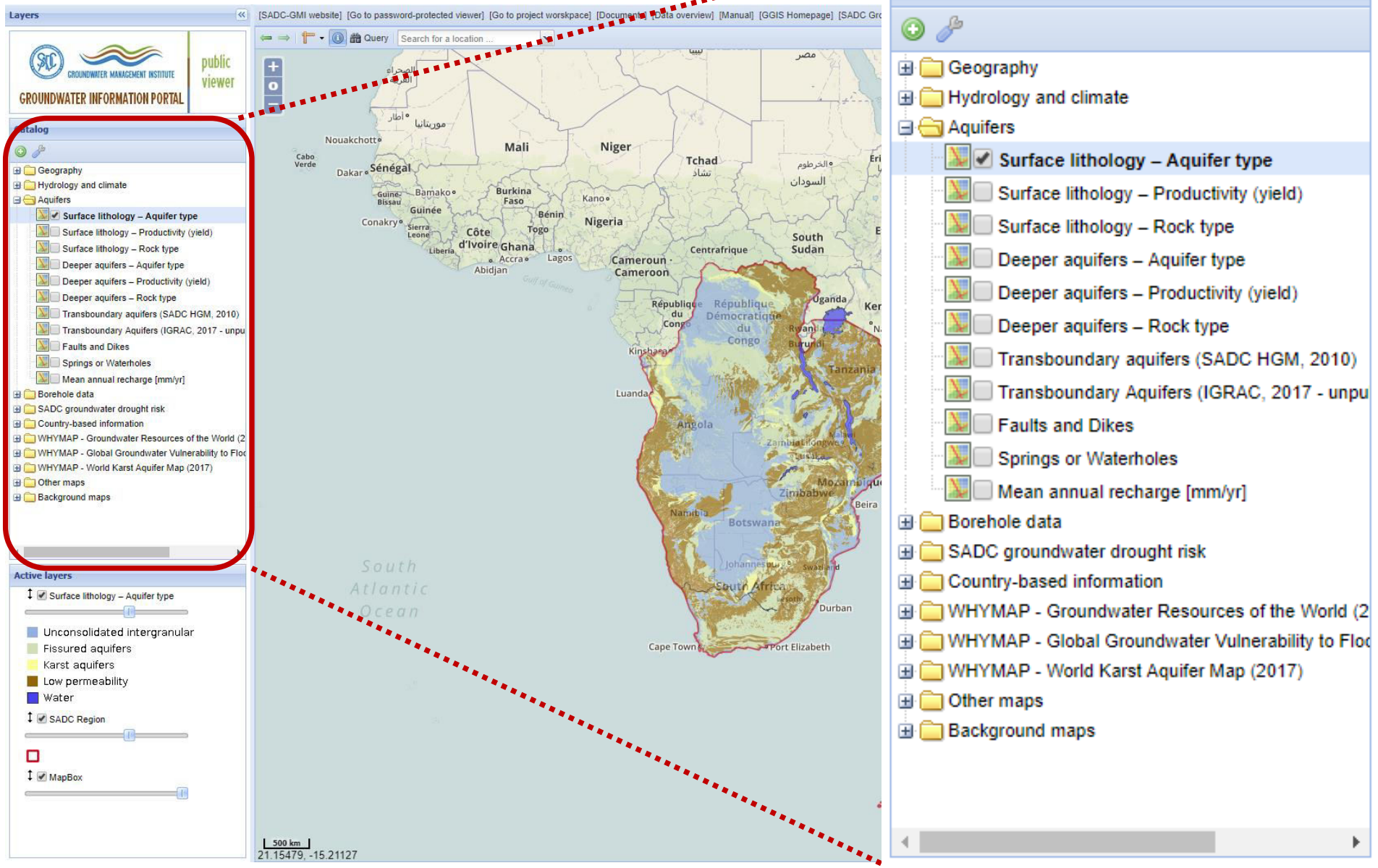
Screenshot of original SADC-HGM web application (source: SADC et.al., 2010)

2014: The system went down.



Wayback machine – Internet archive
https://web.archive.org

2017: Resuscitating the SADC Hydrogeological Map
A viewer was created within the Global Groundwater Information System (GGIS)


Layers
GROUNDWATER MANAGEMENT INSTITUTE
GROUNDWATER INFORMATION PORTAL
public viewer
Catalog
Geography
Hydrology and climate
Aquifers
Surface lithology – Aquifer type
Surface lithology – Productivity (yield)
Surface lithology – Rock type
Deeper aquifers – Aquifer type
Deeper aquifers – Productivity (yield)
Deeper aquifers – Rock type
Transboundary aquifers (SADC HGM, 2010)
Transboundary Aquifers (IGRAC, 2017 - unpu
Faults and Dikes
Springs or Waterholes
Mean annual recharge [mm/yr]
Borehole data
SADC groundwater drought risk
Country-based information
WHYMAP - Groundwater Resources of the World (2
WHYMAP - Global Groundwater Vulnerability to Floc
WHYMAP - World Karst Aquifer Map (2017)
Other maps
Background maps
Active layers
Surface lithology – Aquifer type
Unconsolidated intergranular
Fissured aquifers
Karst aquifers
Low permeability
Water
SADC Region
MapBox
[SADC-GMI website] [Go to password-protected viewer] [Go to project worskpace] [Documents] [Data overview] [Manual] [GGIS Homepage] [SADC Gro
Query
Search for a location ...
Mali
Niger
Tchad
Nigeria
Sénégal
Ghana
Côte d'Ivoire
Burkina Faso
Guinée
Cameroun
Cameroon
Centrafrique
South Sudan
Uganda
Tanzania
Angola
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Zimbabwe
Namibia
Botswana
South Africa
Durban
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Port Elizabeth
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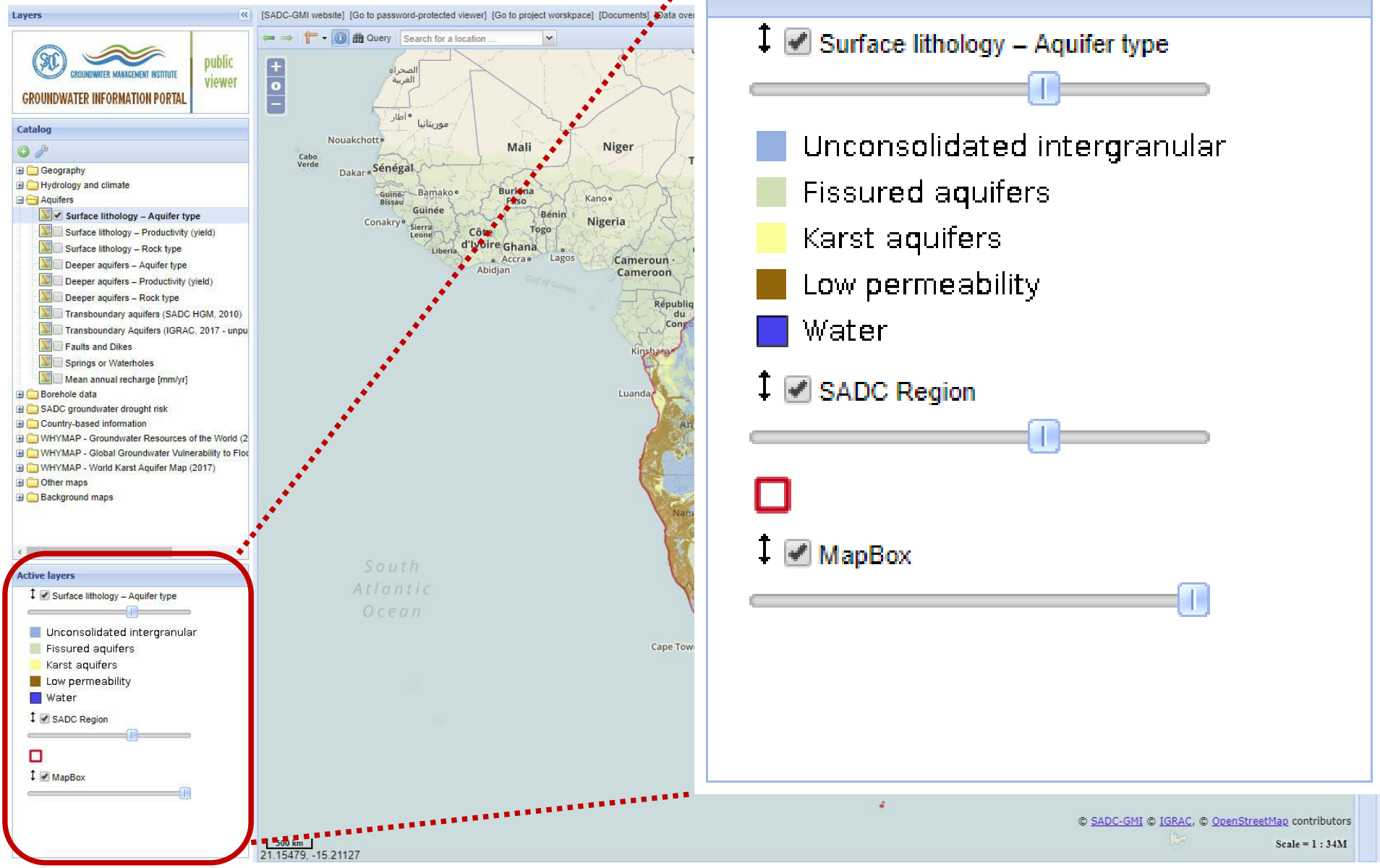
Layers
GROUNDWATER MANAGEMENT INSTITUTE
GROUNDWATER INFORMATION PORTAL
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Catalog
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Query
Search for a location ...
Mali
Niger
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Guinée
Conakry
Burkina Faso
Bénin
Togo
Ghana
Accra
Lagos
Abidjan
Cameroun
Cameroon
Luanda
South Atlantic Ocean
500 km
21.15479, -15.21127
© SADC-GMI © IGRAC, © OpenStreetMap contributors
Scale = 1 : 34M
Active layers
Surface lithology – Aquifer type
Unconsolidated intergranular
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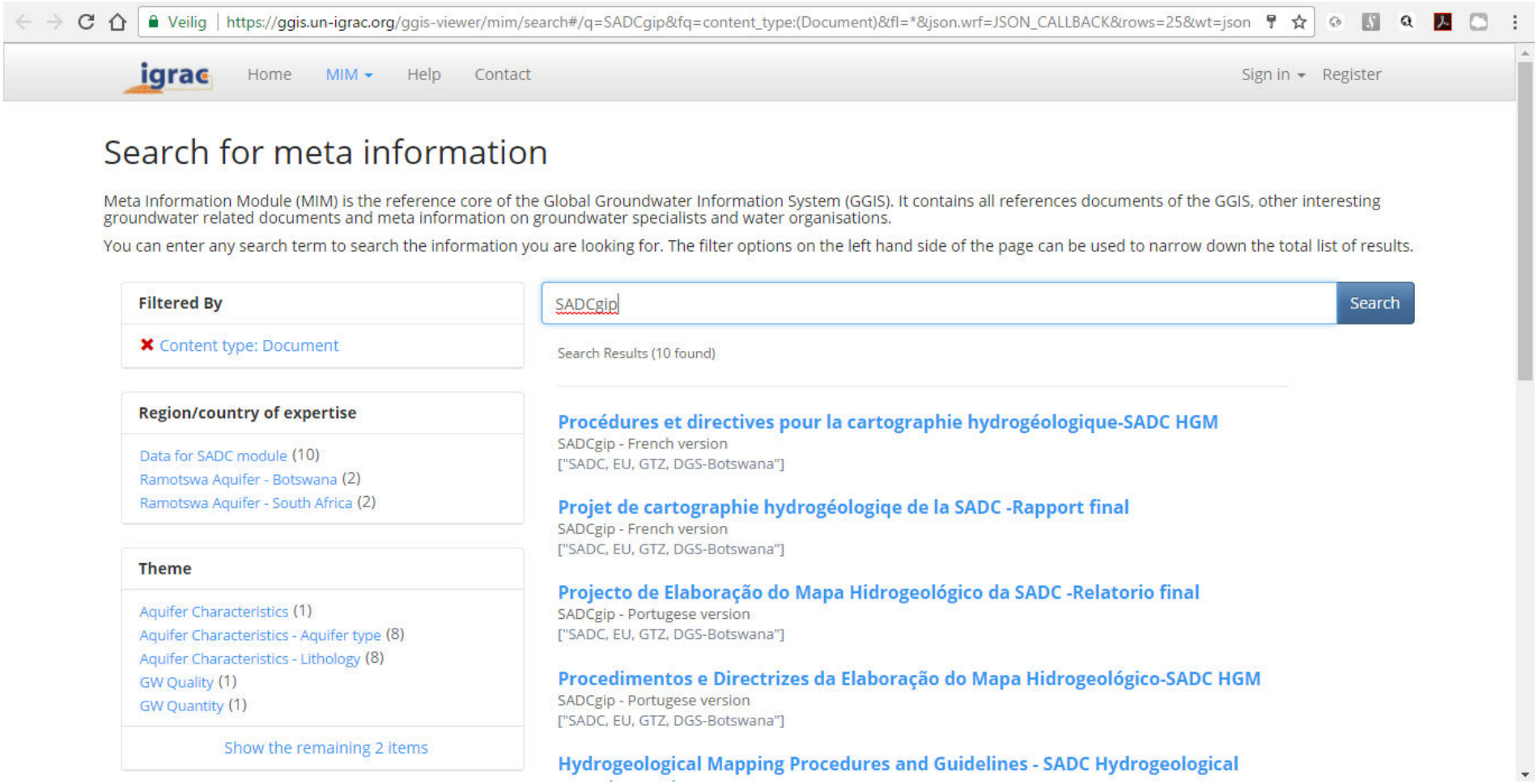
Karst aquifers
Low permeability
Water
SADC Region
MapBox

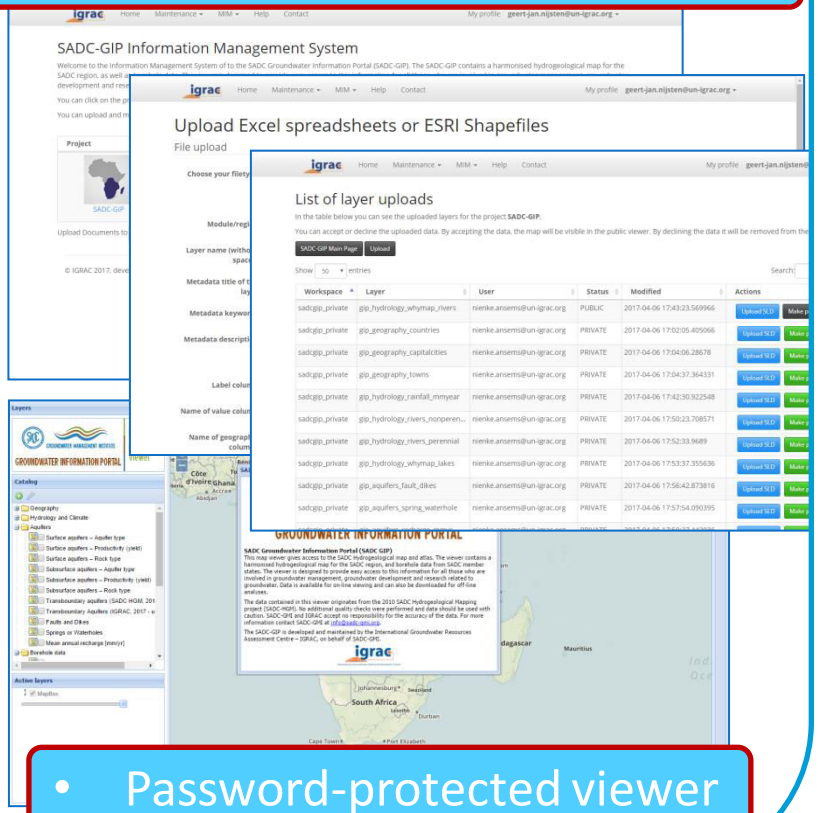

Veilig | https://ggis.un-igrac.org/ggis-viewer/mim/search#/q=SADCgip&fq=content_type:(Document)&fl=*&json.wrf=JSON_CALLBACK&rows=25&wt=json
igrac
Home
MIM
Help
Contact
Sign in
Register
Search for meta information
Meta Information Module (MIM) is the reference core of the Global Groundwater Information System (GGIS). It contains all references documents of the GGIS, other interesting groundwater related documents and meta information on groundwater specialists and water organisations.
You can enter any search term to search the information you are looking for. The filter options on the left hand side of the page can be used to narrow down the total list of results.
Filtered By
Content type: Document
Region/country of expertise
Data for SADC module (10)
Ramotswa Aquifer - Botswana (2)
Ramotswa Aquifer - South Africa (2)
Theme
Aquifer Characteristics (1)
Aquifer Characteristics - Aquifer type (8)
Aquifer Characteristics - Lithology (8)
GW Quality (1)
GW Quantity (1)
Show the remaining 2 items
SADCgip
Search
Search Results (10 found)
Procédures et directives pour la cartographie hydrogéologique-SADC HGM
SADCgip - French version
["SADC, EU, GTZ, DGS-Botswana"]
Projet de cartographie hydrogéologiqe de la SADC -Rapport final
SADCgip - French version
["SADC, EU, GTZ, DGS-Botswana"]
Projecto de Elaboração do Mapa Hidrogeológico da SADC -Relatorio final
SADCgip - Portugese version
["SADC, EU, GTZ, DGS-Botswana"]
Procedimentos e Directrizes da Elaboração do Mapa Hidrogeológico-SADC HGM
SADCgip - Portugese version
["SADC, EU, GTZ, DGS-Botswana"]
Hydrogeological Mapping Procedures and Guidelines - SADC Hydrogeological

ANYONE with internet access:

- Public viewer

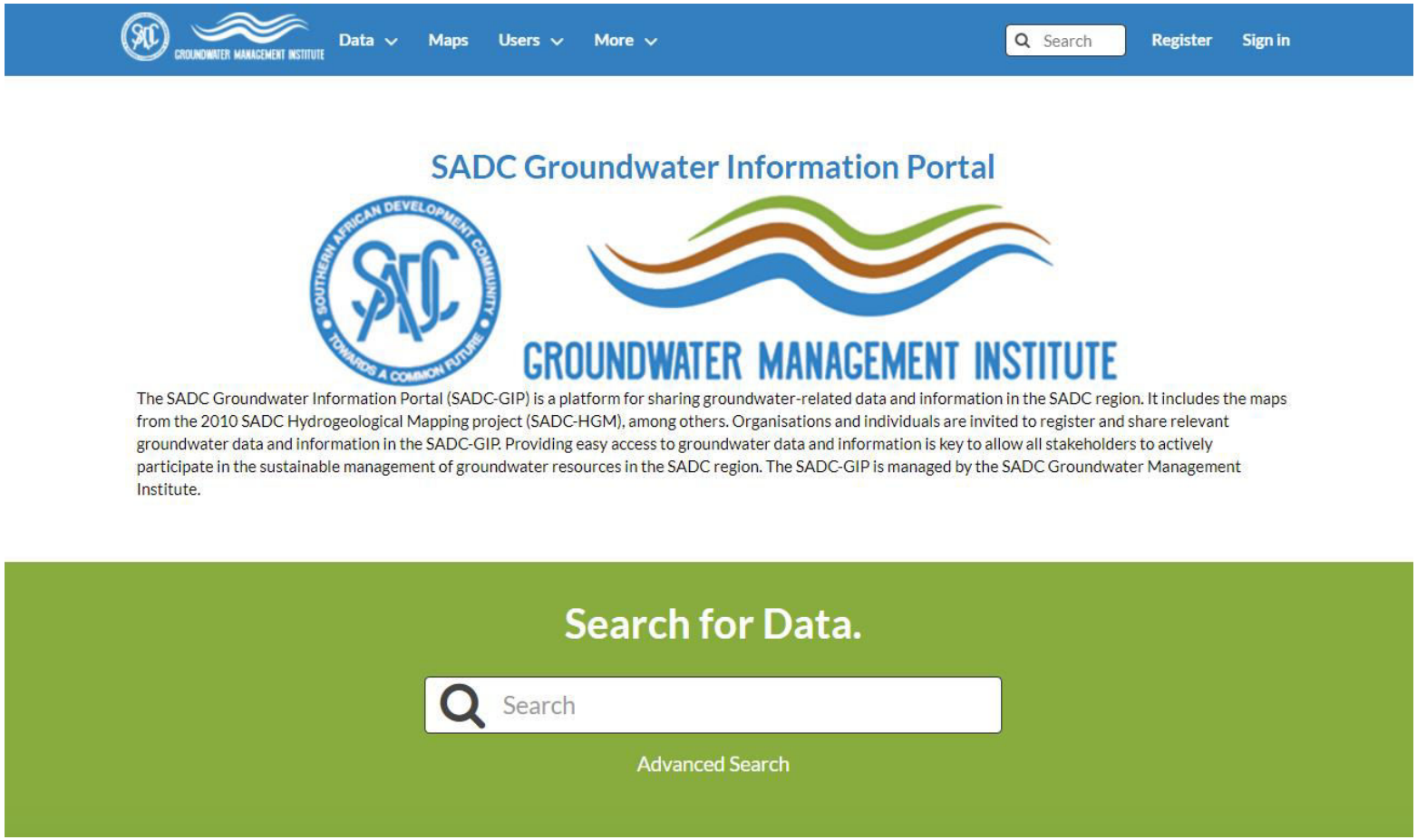
REGISTERED & AUTHORISED users:

- Password-protected workspace

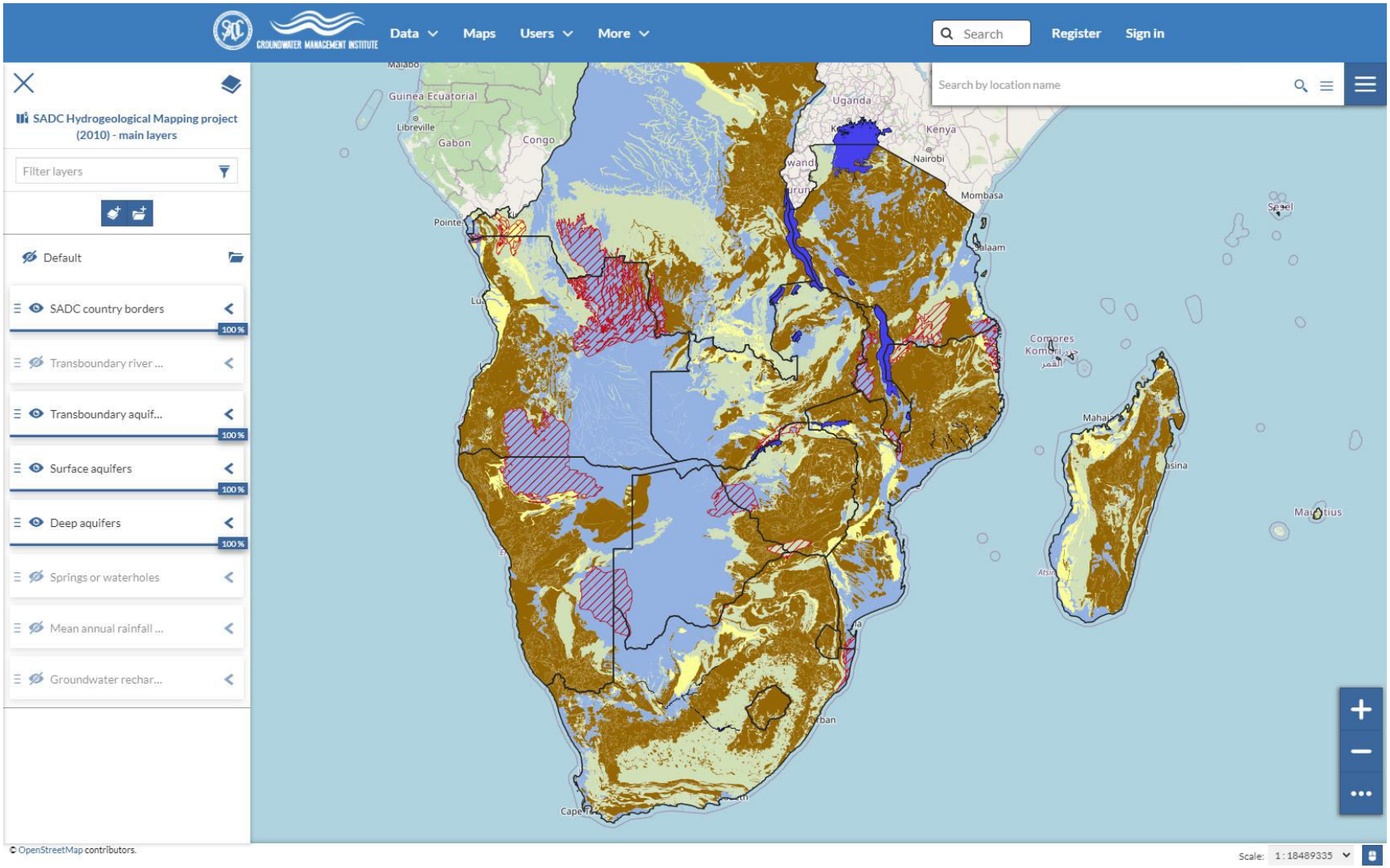


- Password-protected viewer

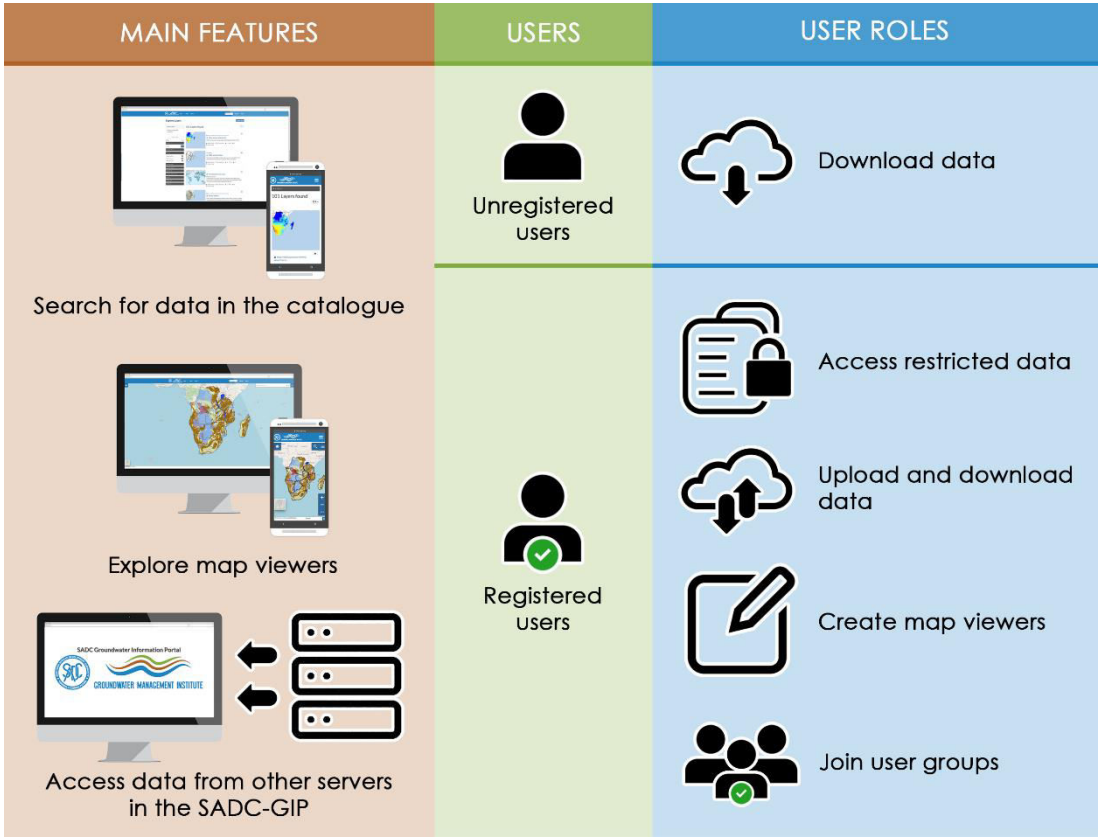
2019-2020: Expanding the SADC-GIP



www.sadc-gip.org

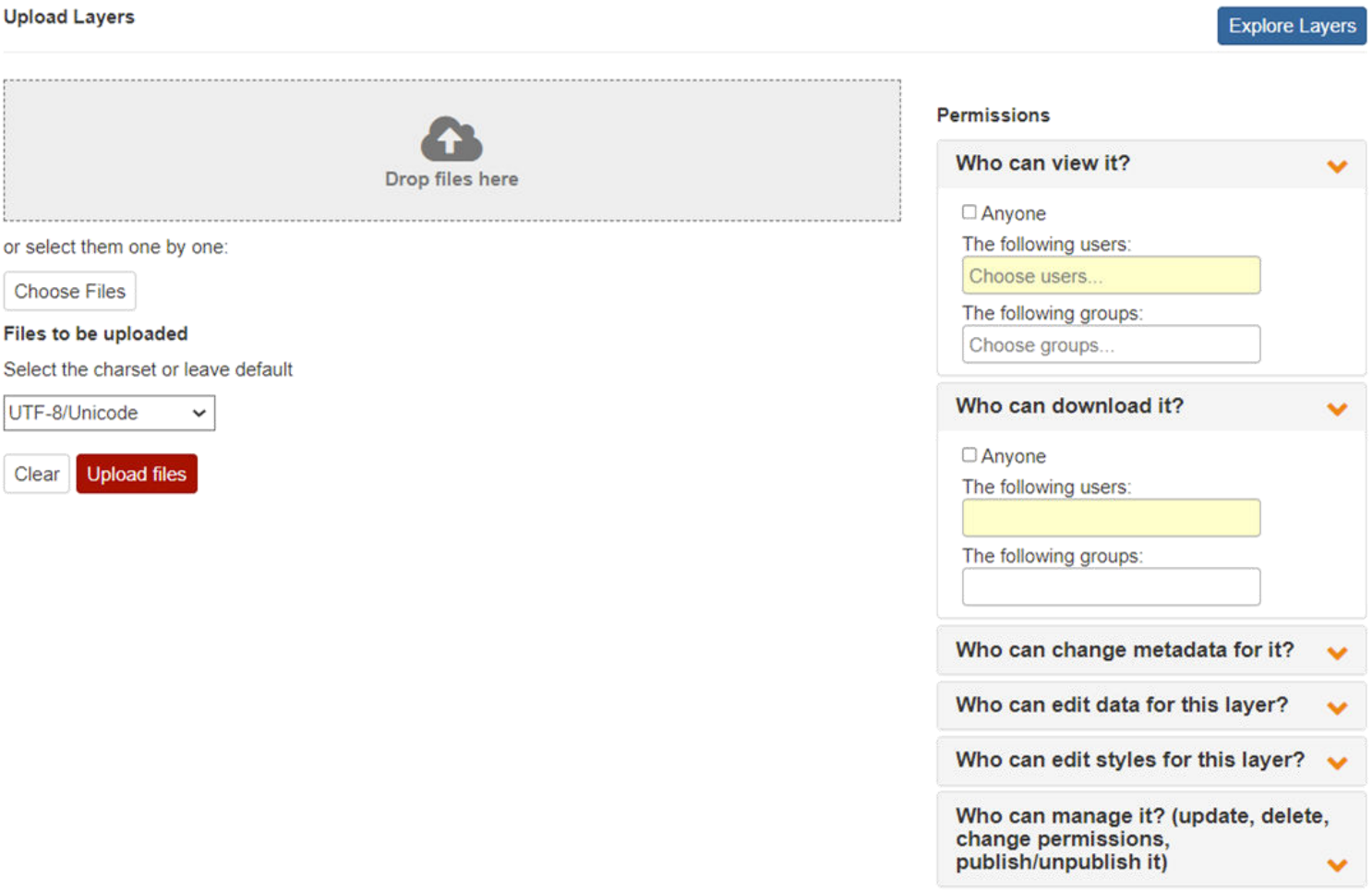


- The new SADC-GIP operates as a Spatial Data Infrastructure, where many users can register for uploading/accessing data.



In most countries, the majority of groundwater data and information is held by the state, e.g. ministry of water, water authority (national or decentralized), geological survey… but additional data might be held by other ministries or departments, river basin organisations, water companies, universities, NGOs, private companies, etc.

Data providers remain in control of their data, through permissions and licenses.



- Licenses can be applied on the data

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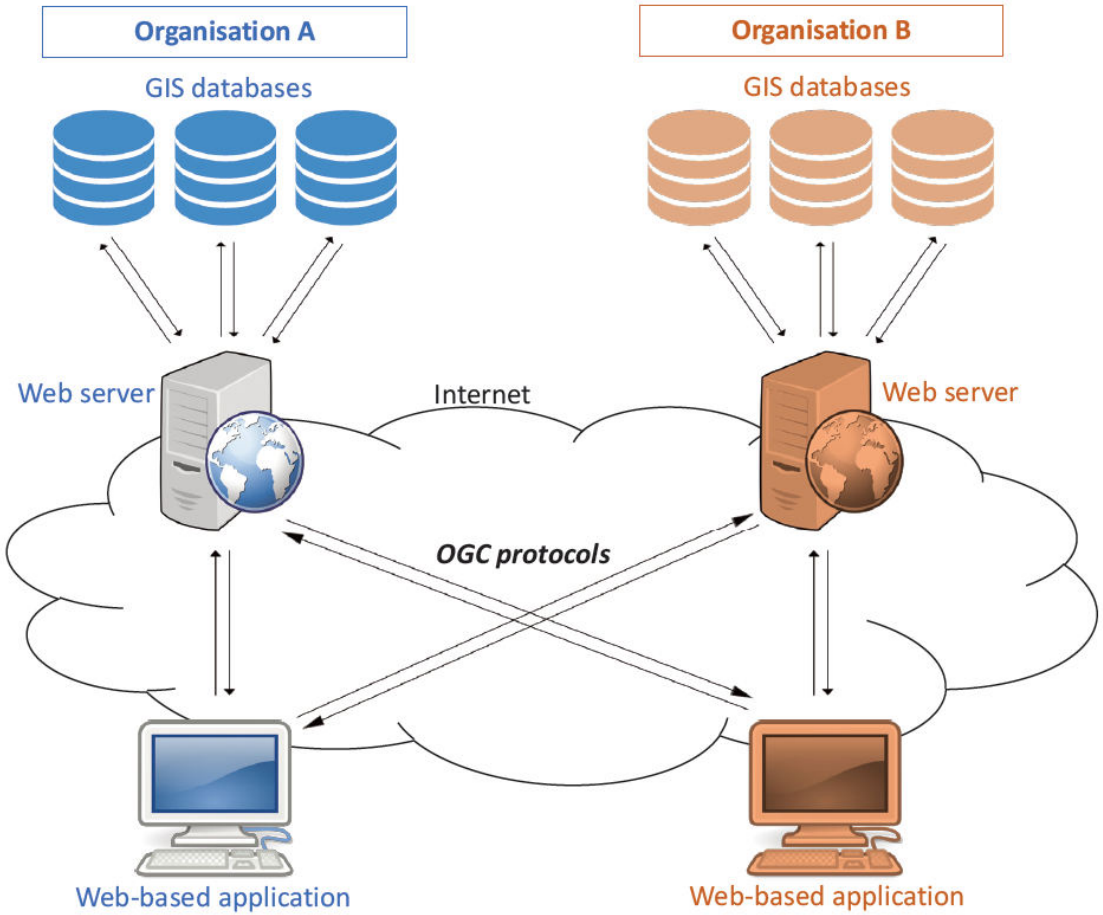
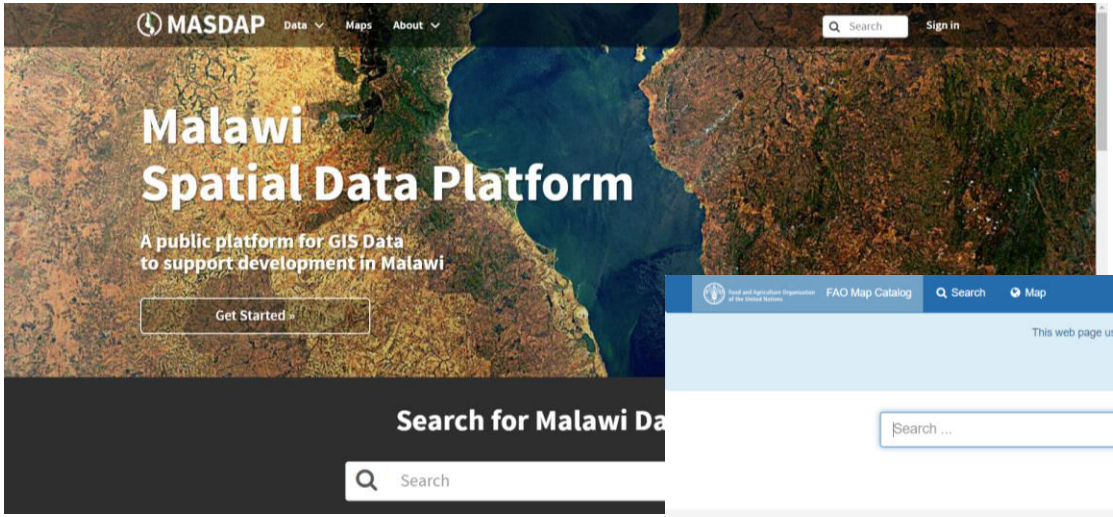
- It supports international standards for spatial data exchange.



- Data providers decide who has access to the data and to what level
- Data users have access to up-to-date data
- Data users don't have to store the data
- If not OGC standards, API can be tailored (but then the exchange of data is dependent of the application)

SADC-GMI, IGRAC, IGS (2019) SADC Framework for Groundwater Data Collection and Data Management.


MASDAP
Data
Maps
About
Search
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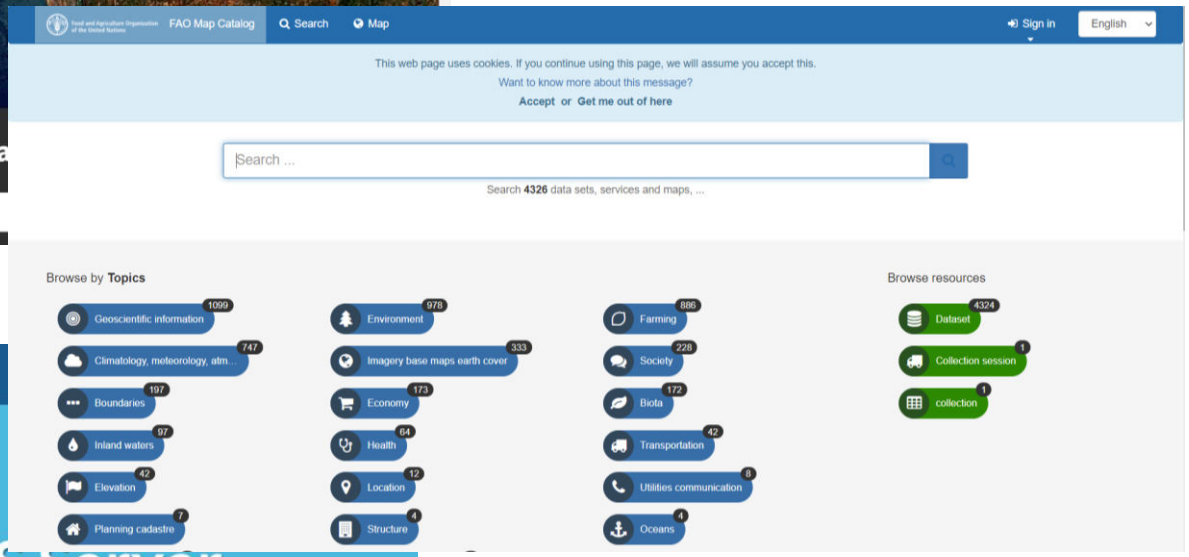
Malawi
Spatial Data Platform
A public platform for GIS Data
to support development in Malawi
Get Started »
Search for Malawi Da
Search


FAO Map Catalog
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Map
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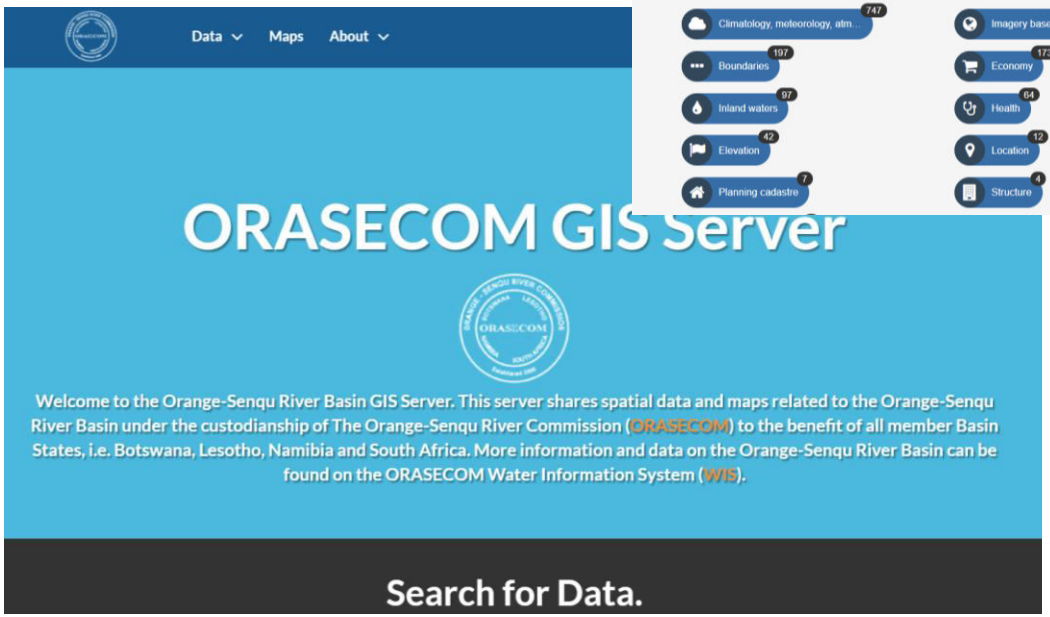
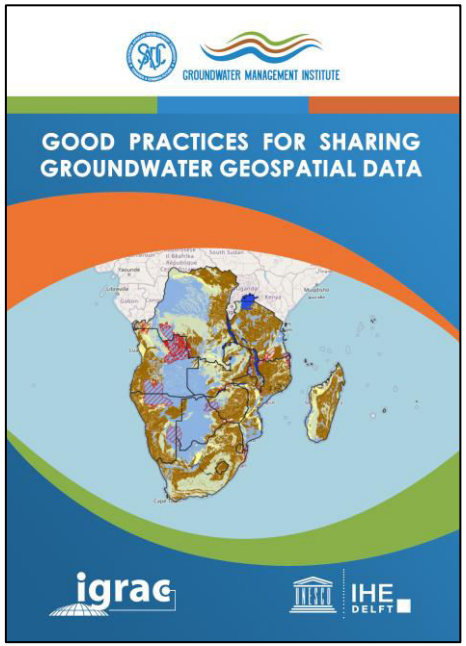
Search 4326 data sets, services and maps, ...
Browse by Topics
Geoscientific information 1099
Climatology, meteorology, atm... 747
Boundaries 197
Inland waters 97
Elevation 42
Planning cadastre 7
Environment 978
Imagery base maps earth cover 333
Economy 173
Health 64
Location 12
Structure 4
Farming 886
Society 228
Biota 172
Transportation 42
Utilities communication 8
Oceans 4
Browse resources
Dataset 4324
Collection session 1
collection 1


Data
Maps
About
ORASECOM GIS Server
ORASECOM
Welcome to the Orange-Senqu River Basin GIS Server. This server shares spatial data and maps related to the Orange-Senqu River Basin under the custodianship of The Orange-Senqu River Commission (ORASECOM) to the benefit of all member Basin States, i.e. Botswana, Lesotho, Namibia and South Africa. More information and data on the Orange-Senqu River Basin can be found on the ORASECOM Water Information System (WIS).
Search for Data.

- It supports extensive metadata.

Many data are useless if not accompanied with metadata, e.g. coordinate system (for spatial data), units (for measurements), methodology, etc.

→ Metadata are crucial! In particular in transboundary contexts where different standards might be in use



Metadata can include:

- the coordinate system
- the original data used to produce the layer
- the method used to produce the layer
- the measurement units
- the resolution
- the date
- the author(s)
- the owner(s) of the data
- the license or restrictions to share and use the data

3.2. Metadata required for monitoring data

Some metadata are collected in relation to the function of the data point: groundwater level monitoring well, groundwater sample point, and groundwater abstraction/flow discharge point.

3.2.1. Groundwater level

- Unit: Length. usually meters or feet
- Reference point to start measuring (e.g. sea level or ground surface)
- Date of recording (preferably including year, month, day, hour, minute and second)
- Method of measurement: manually or automatically. When data loggers are used, extra metadata should be collected following the instructions of the provider of the equipment (e.g. depth to probe, atmospheric correction, etc)

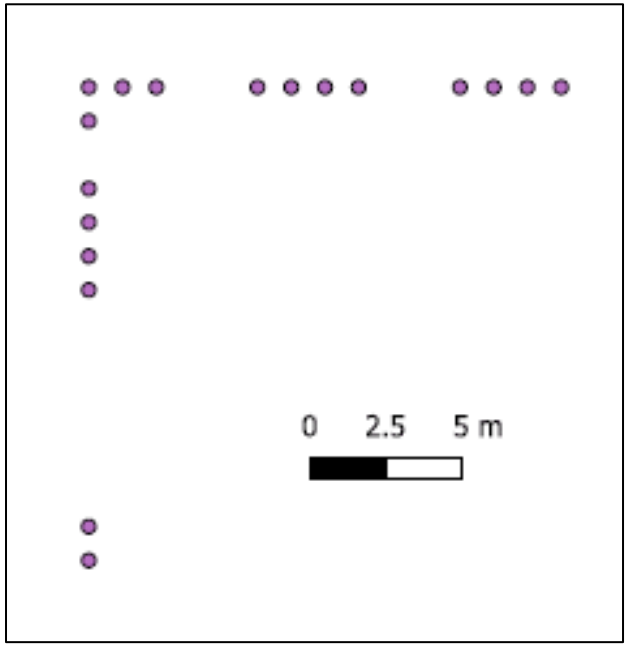
3.2.2. Groundwater quality

- Name of parameter, for instance: pH, temperature, total dissolved solids, etc.
- Unit (of concentration), for instance mg/L, ppm, pH units, etc.
- Method of measurement: Including whether it was measured in the field or in the laboratory, and which method was used (e.g. electrochemical analysis, spectroscopy, etc)
- Name of laboratory
- Relevant dates: Date of measuring in the field, date of sample collection, date of analysis in the laboratory.

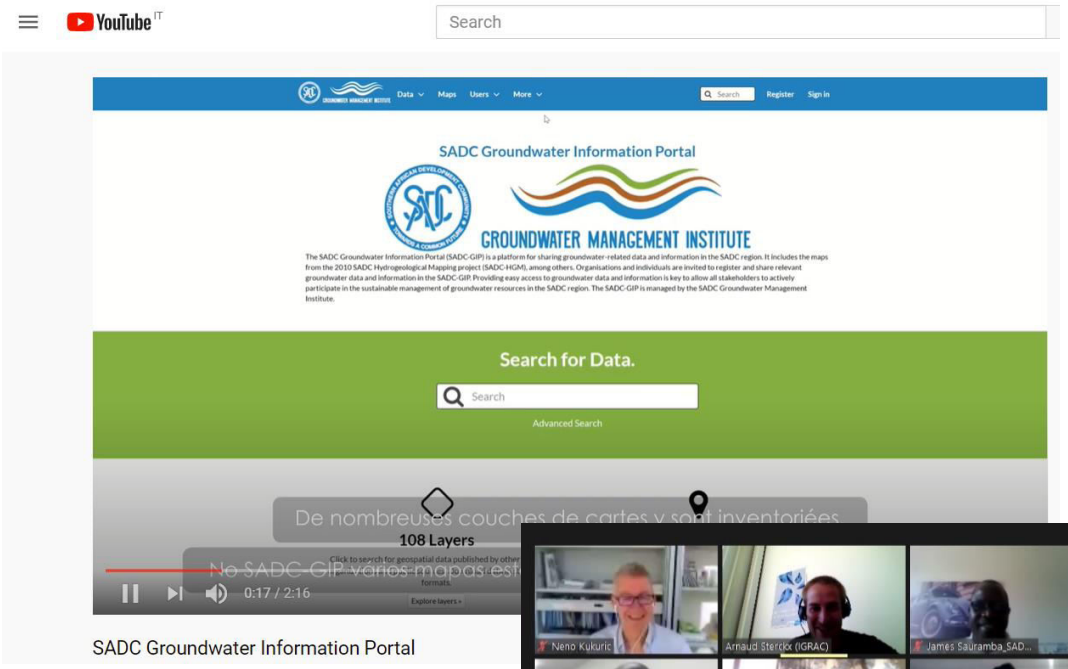
3.2.3. Groundwater abstraction

- Unit (volume/time, for example m3/L)
- Method of measurement: flowmeter, bucket/chronometer
- Date (preferably including year, month, day, hour, minute and second)

Big Data Analytics and Transboundary Water Collaboration, 2019

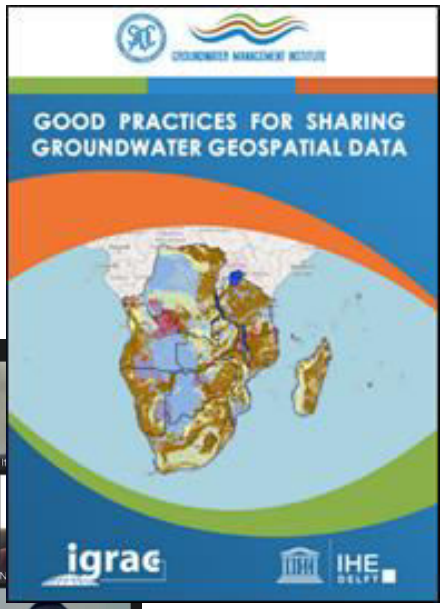


Training material was produced, and workshops were held to reach out and engage national water departments in SADC



SADC Groundwater Information Portal

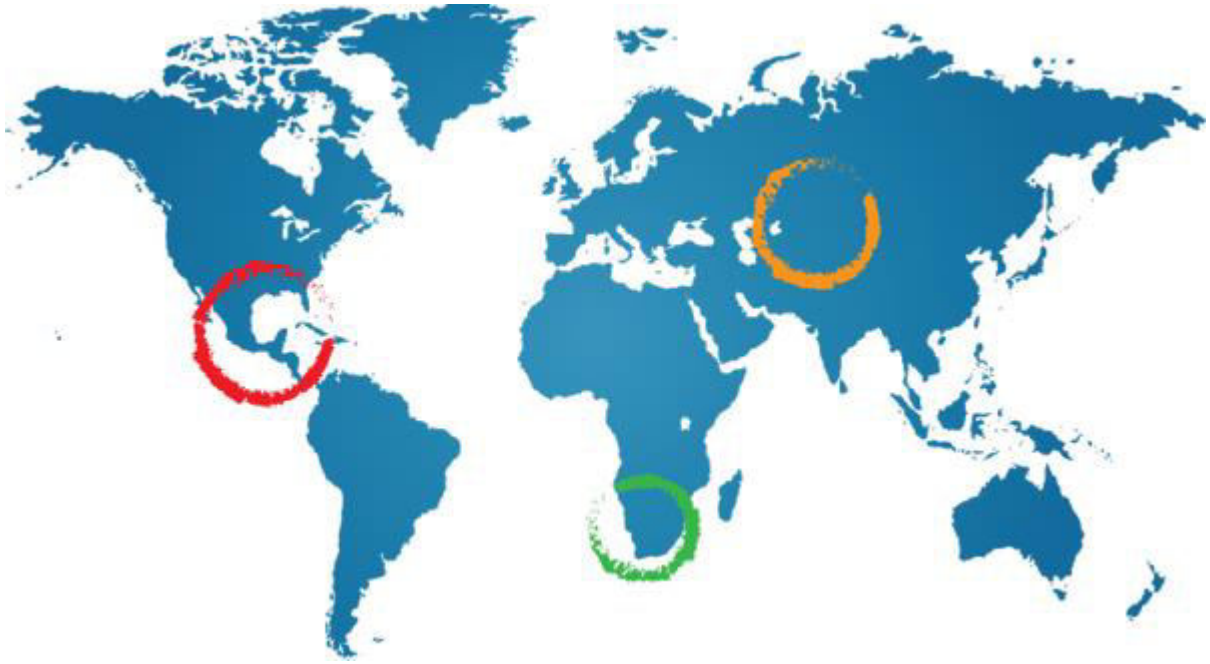
https://www.youtube.com/watch?v=1_loHepwv9g&feature=youtu.be

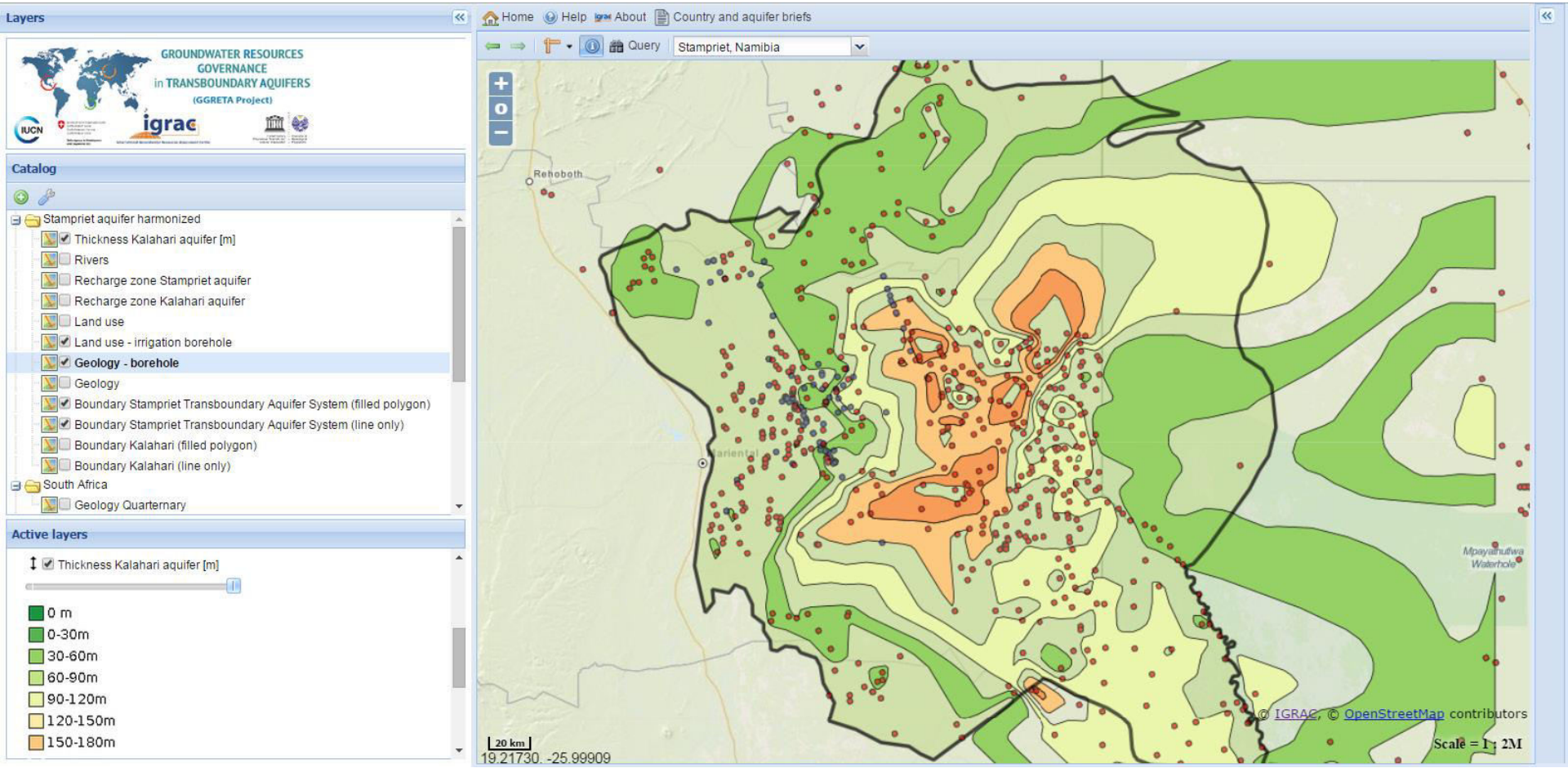


The Stampriet Information Management System

2013-2015: GGRETA project – phase I, Stampriet Transboundary Aquifer System (Botswana, Namibia, South Africa)

3 pilot studies to advance “Governance of Groundwater Resources in Transboundary Aquifers”




Layers
GROUNDWATER RESOURCES GOVERNANCE in TRANSBOUNDARY AQUIFERS
(GGRETA Project)
Catalog
Stampriet aquifer harmonized
Thickness Kalahari aquifer [m]
Rivers
Recharge zone Stampriet aquifer
Recharge zone Kalahari aquifer
Land use
Land use - irrigation borehole
Geology - borehole
Geology
Boundary Stampriet Transboundary Aquifer System (filled polygon)
Boundary Stampriet Transboundary Aquifer System (line only)
Boundary Kalahari (filled polygon)
Boundary Kalahari (line only)
South Africa
Geology Quarternary
Active layers
Thickness Kalahari aquifer [m]
0 m
0-30m
30-60m
60-90m
90-120m
120-150m
150-180m
Home
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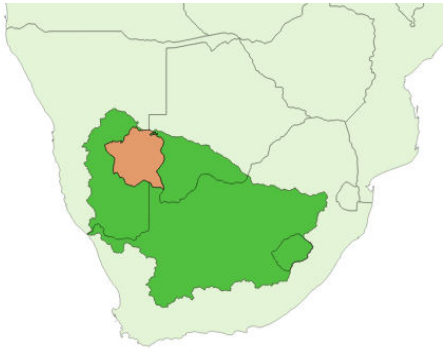
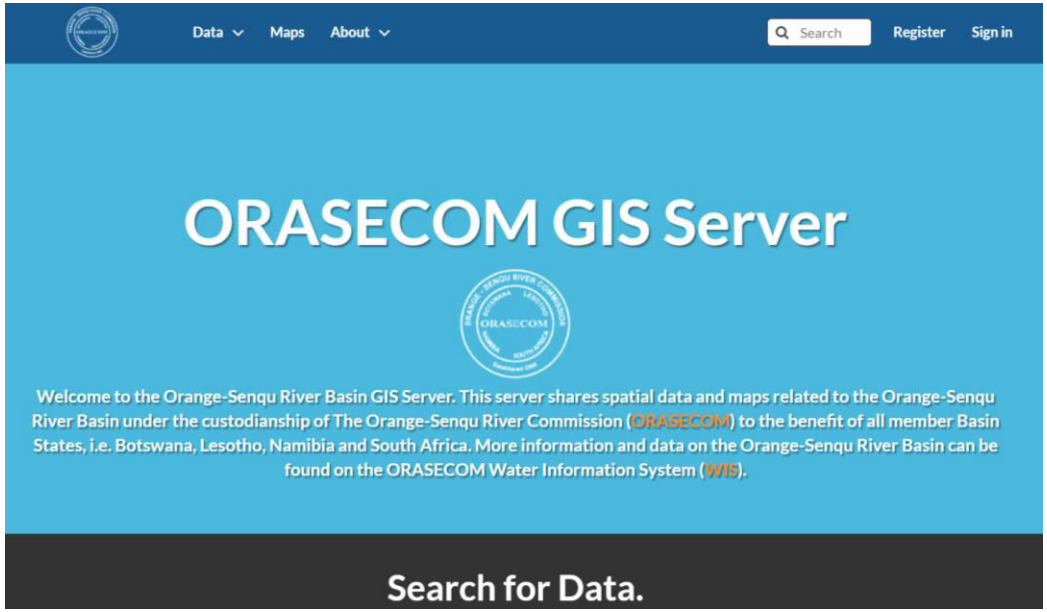
Stampriet, Namibia
Rehoboth
Mpayathuthwa Waterhole
© IGRAC, © OpenStreetMap contributors
20 km
19.21730, -25.99909
Scale = 1 : 2M

2018: The Multi-Country Cooperation Mechanism (MCCM) of the STAS was integrated to the Ground Water Hydrology Committee (GWHC) of ORASECOM.



Location of the Stampriet Transboundary Aquifer System (in orange) and the Orange-Senqu River Basin (in green) (UNESCO-IHP & ORASECOM, 2018)

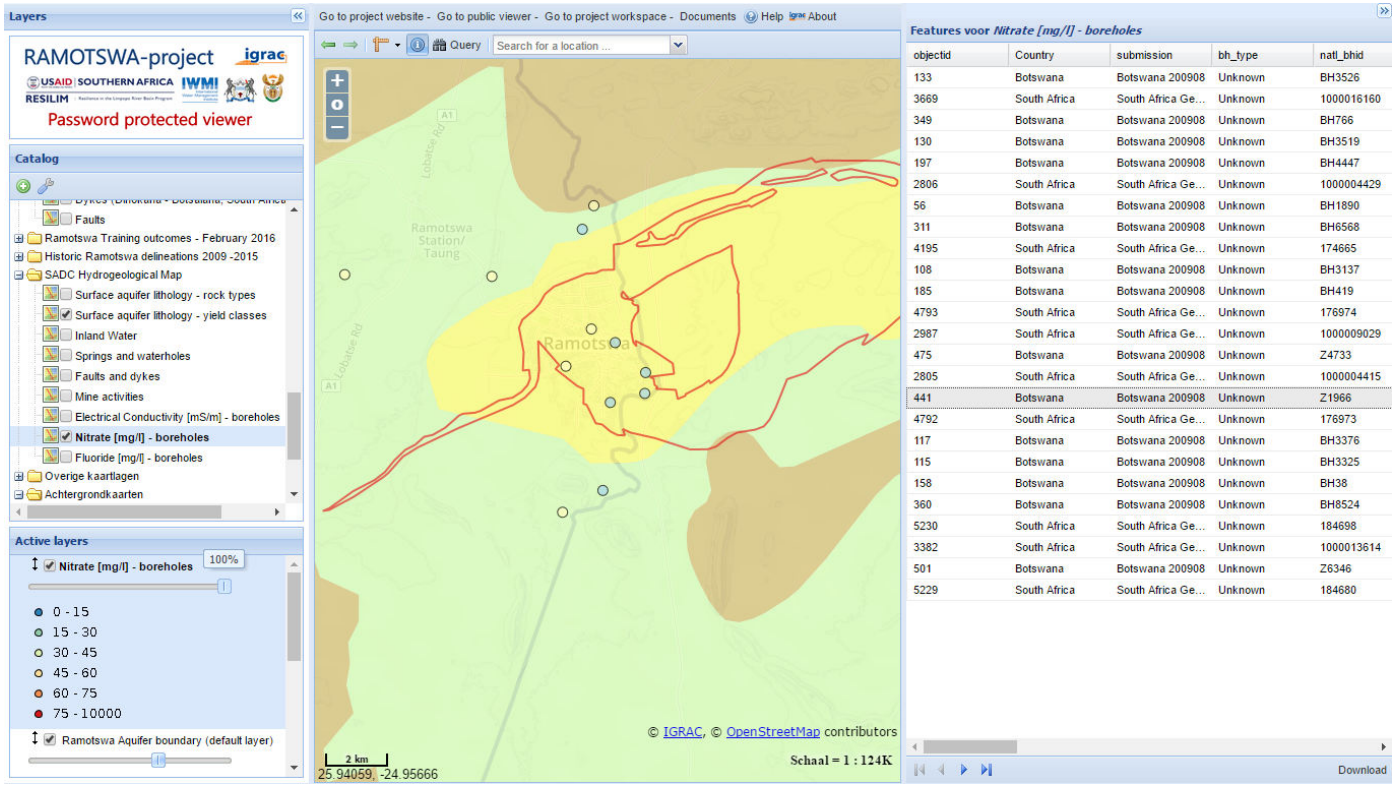
Launch of a new information management system at ORASECOM
gis.orasecom.org



The Ramotswa Information Management System (RIMS)

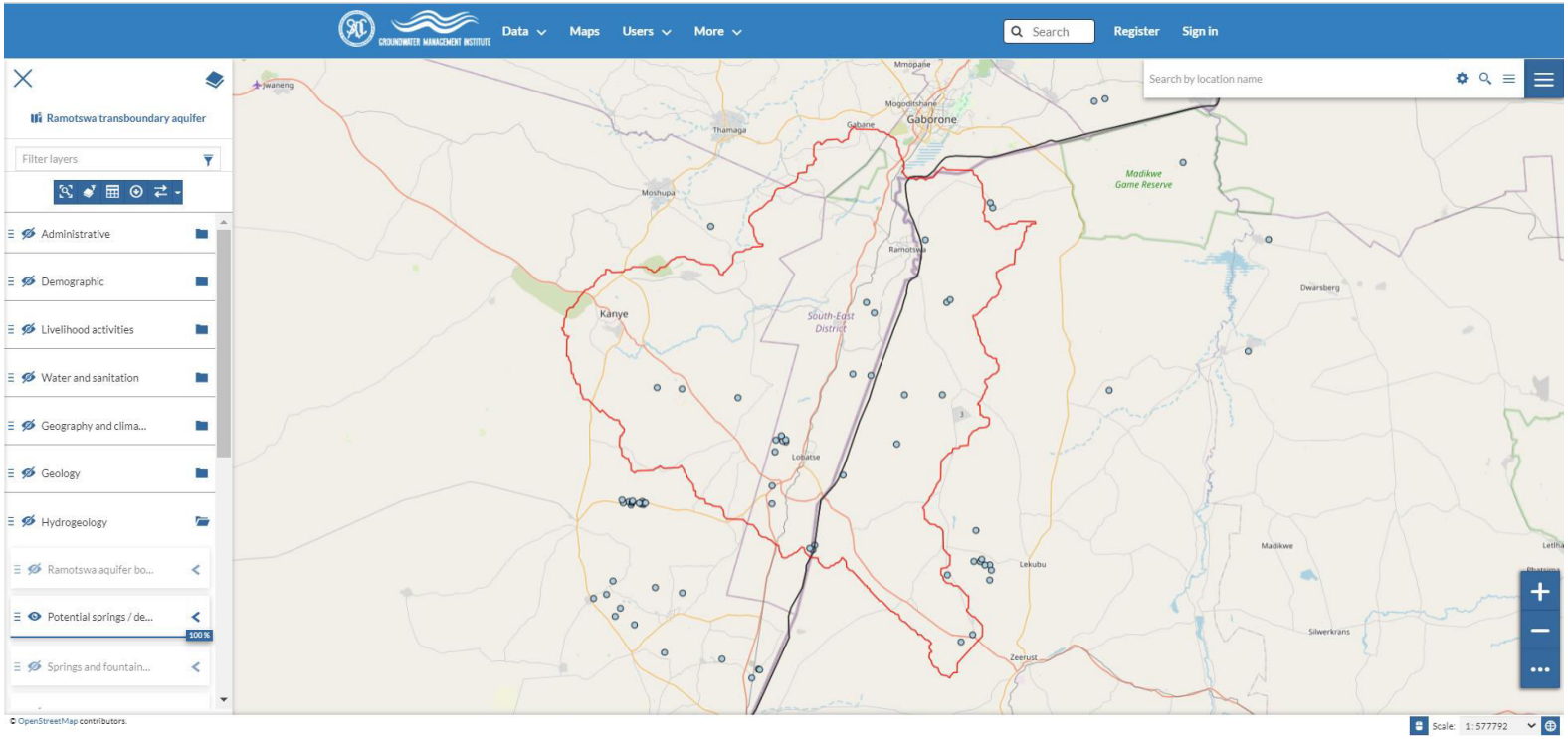
2015-2017: Ramotswa project – phase I (Botswana, South Africa)

The Ramotswa aquifer is a small transboundary aquifer close to Gaborone.



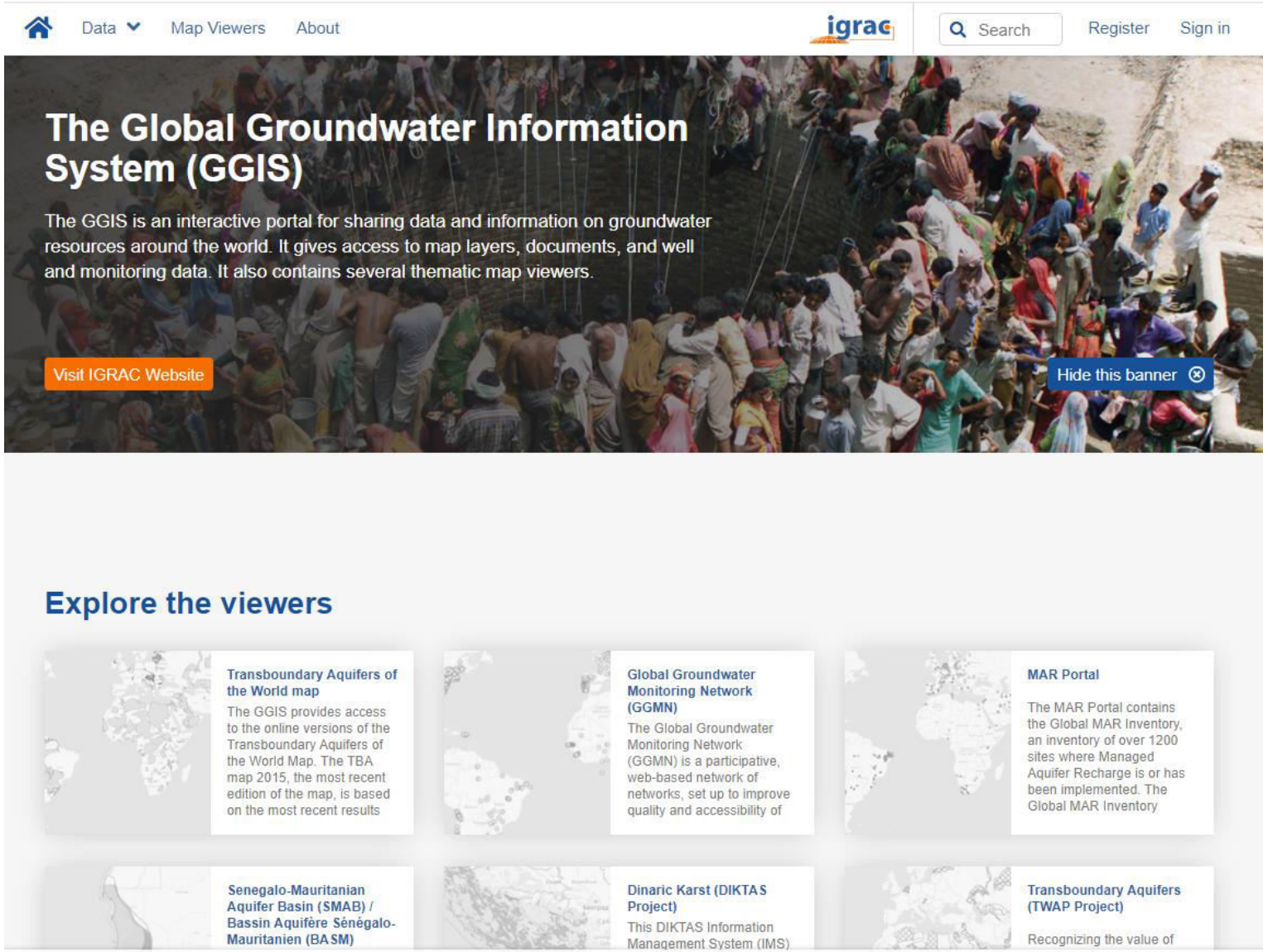
2019: LIMCOM launched its first Groundwater Committee to address conjunctive management of surface water and groundwater resources, with a focus on the 3 TBAs identified to date in the basin, among which the Ramotswa aquifer.

Support of LIMCOM by SADC-GMI settled in a MOU.

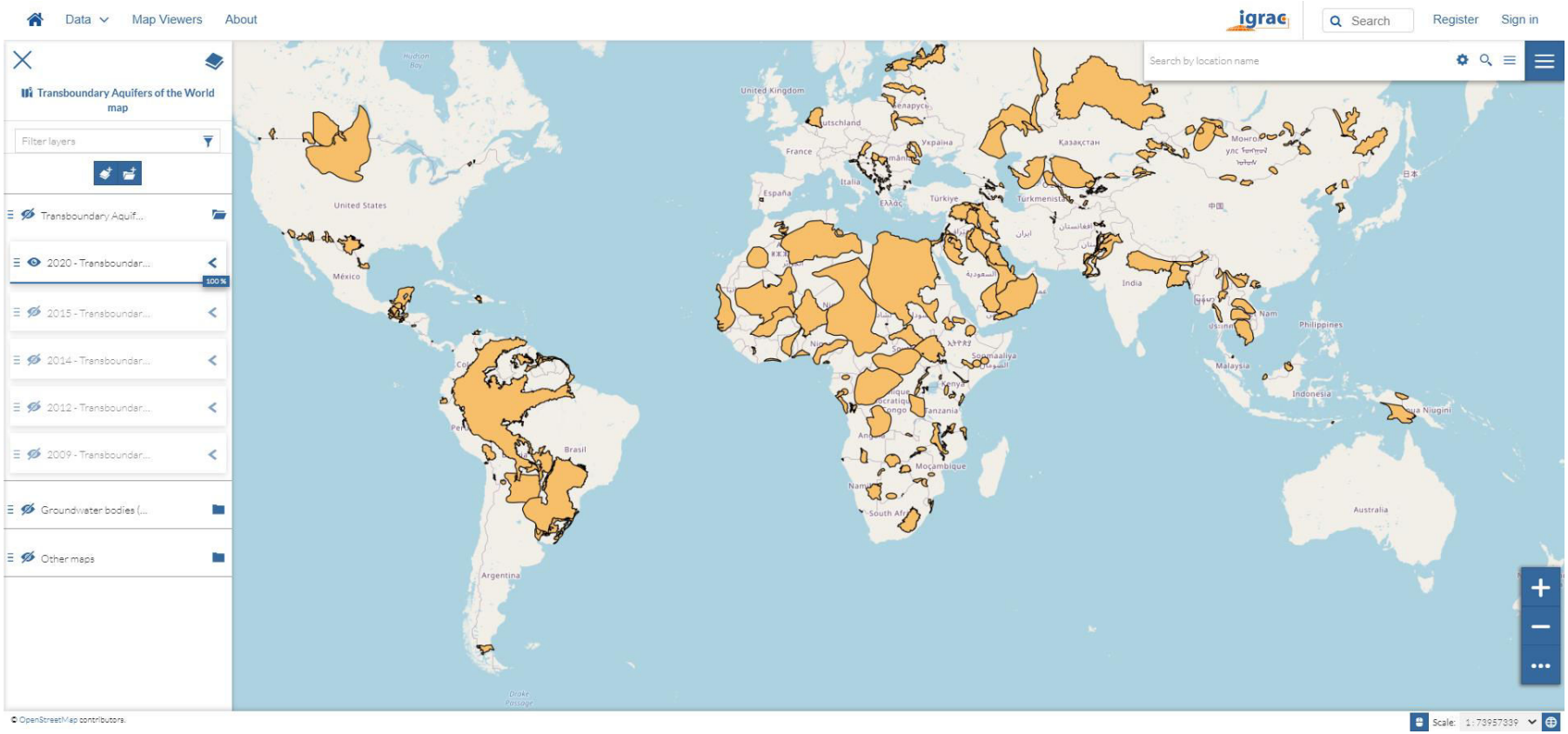


https://ggis.un-igrac.org/

2021

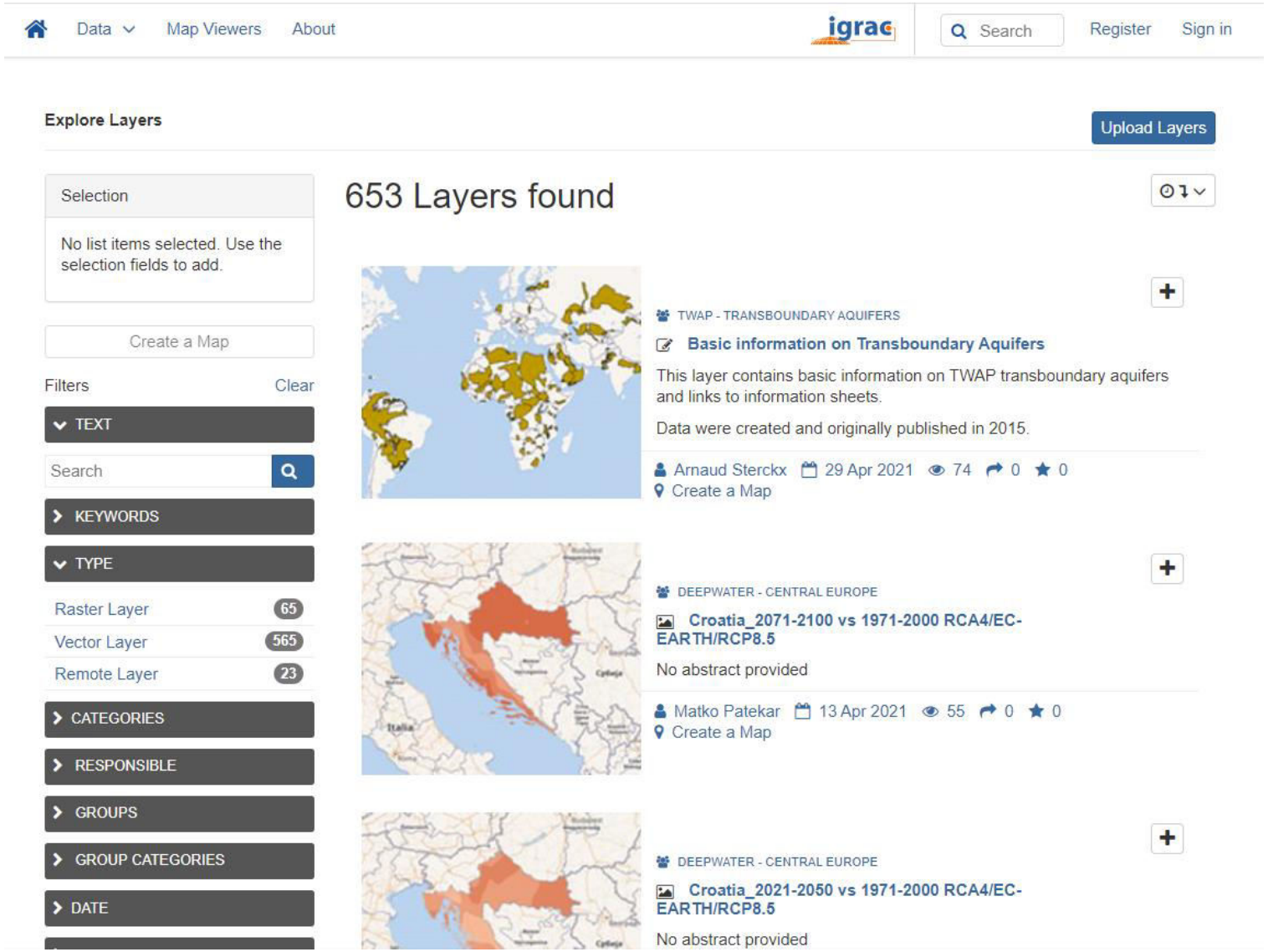


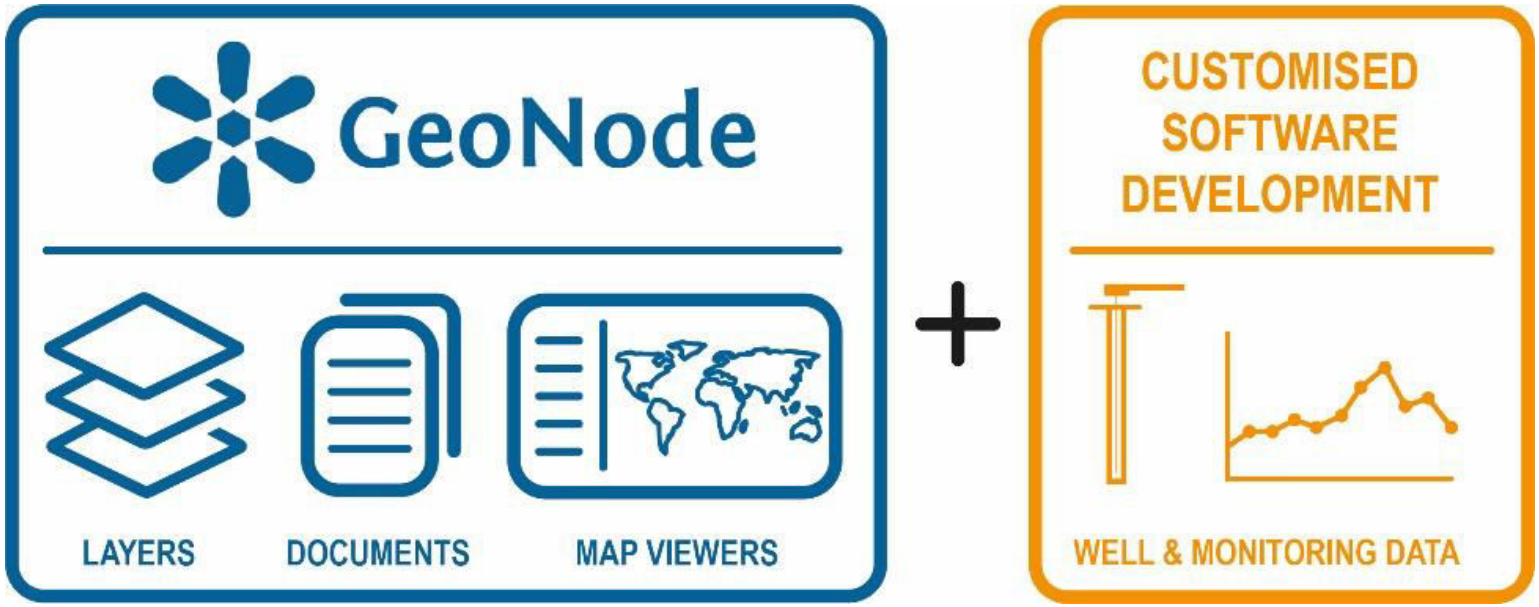
The GGIS contains thematic map viewers
Example : the TBA viewer



https://ggis.un-igrac.org/view/tba

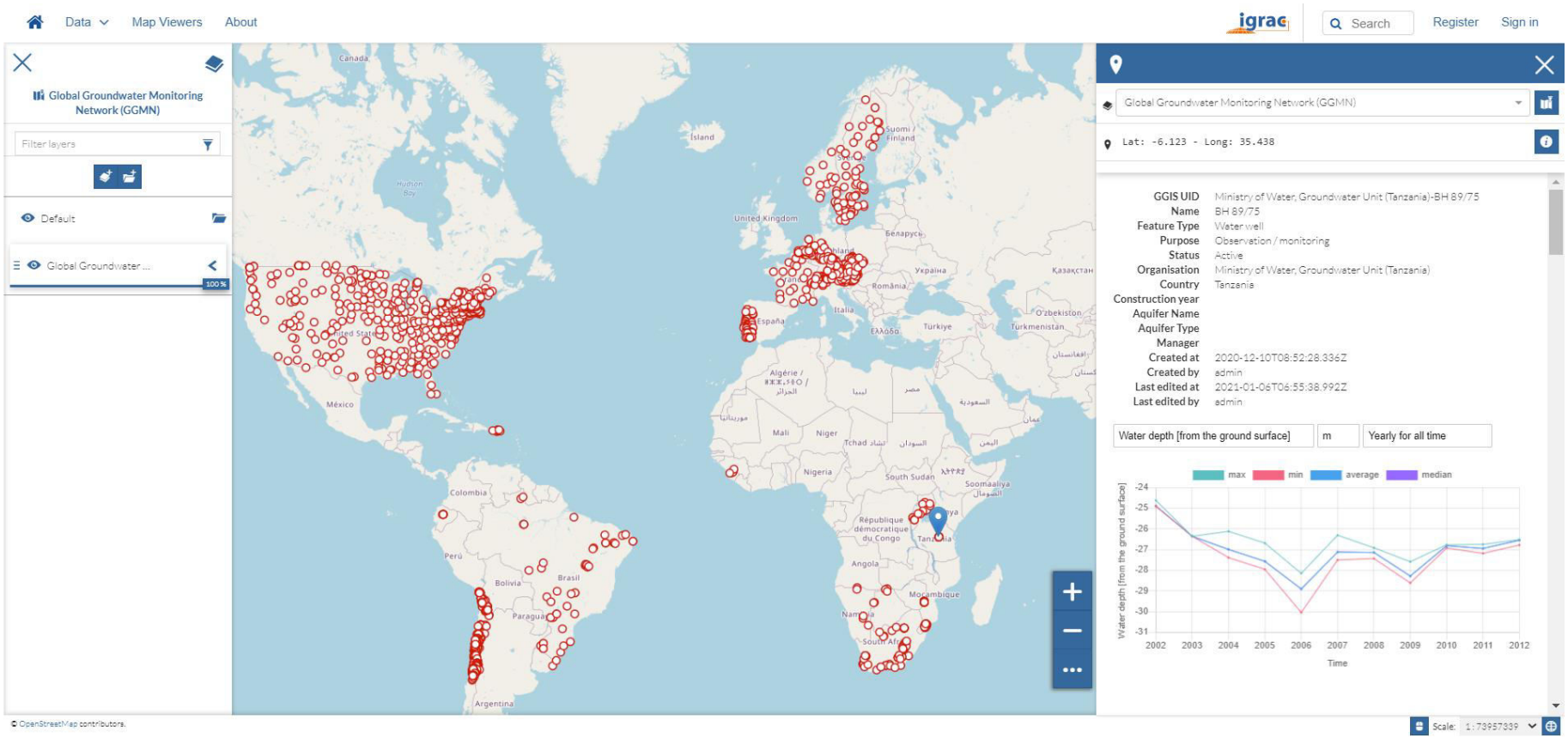
Map layers, documents and well and monitoring data can be accessed





- Free to use
- Development is also open-source and free to share

Well and monitoring data are now integrated in the GGIS



https://ggis.un-igrac.org/view/ggmn

Data | Map Viewers | About | igrac | Search | Register | Sign in

Well and Monitoring Data Record

- General Information
- Drilling and Construction
- Hydrogeology
- Management
- Monitoring Data
- Groundwater Level
- Groundwater Quality
- Abstraction / Discharge
- Metadata

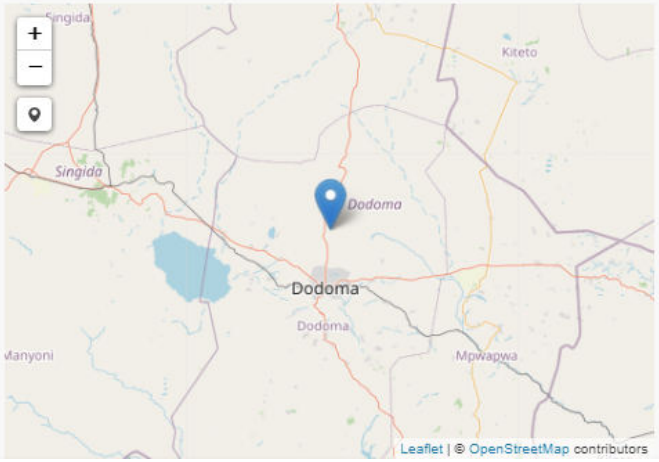
GENERAL INFORMATION

Identification

GGIS UID	Ministry of Water, Groundwater Unit (Tanzania)-BH 89/75
Original ID	BH 89/75
Name	BH 89/75
Feature type	Water well
Purpose	Observation / monitoring
Status	Active
Photo	
Description	

Location

Latitude	-5.93617
Longitude	35.76833
Ground surface elevation	1082.0 m
Top of well elevation	
Country	Tanzania
Address	



MAIN FUNCTIONALITIES

- Explore thematic map viewers
- Access public map layers, documents, well and monitoring data

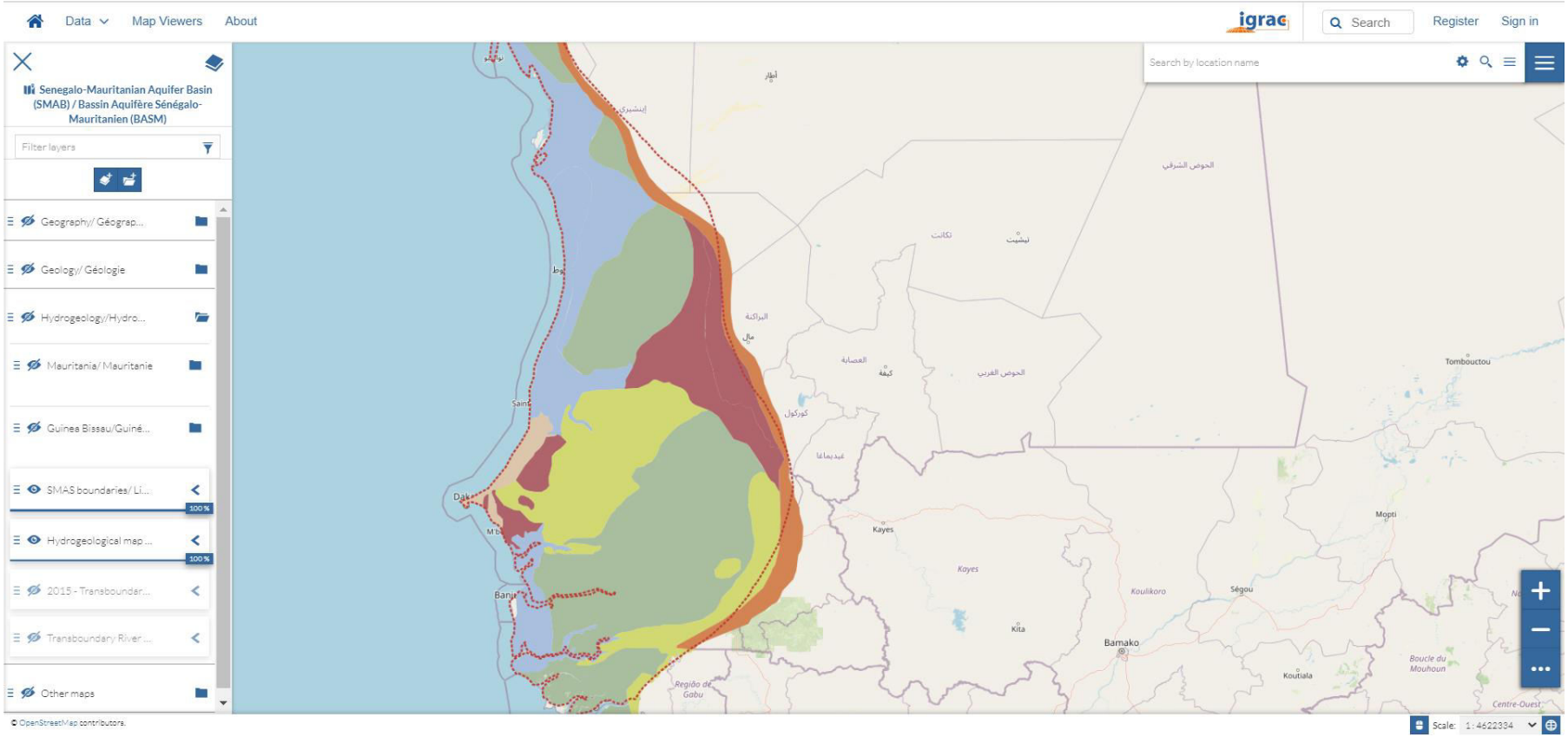
REGISTERED USERS' FUNCTIONALITIES

- Access restricted map layers, documents, well and monitoring data
- Upload and edit data
- Create thematic map viewers
- Join user groups
- Record monitoring data in the field with the GGMN app

ADDITIONAL FEATURES

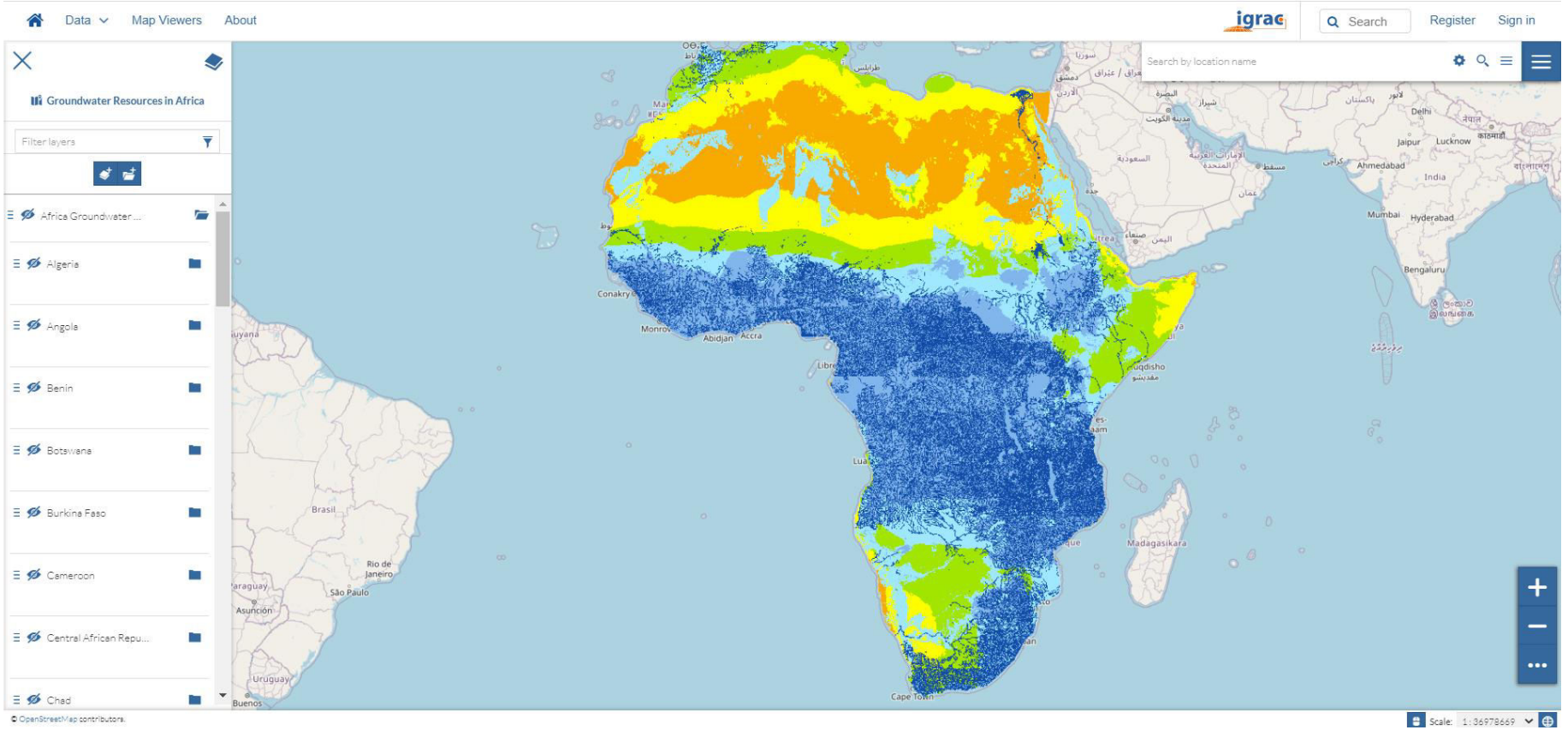
- Exchange map layers via web services
- Set up connections with external well and monitoring databases
- Embed thematic map viewers in external websites

Senegalo-Mauritanian Aquifer Basin viewer



https://ggis.un-igrac.org/view/basm

Groundwater Resources in Africa viewer



https://ggis.un-igrac.org/view/groundwater-resources-africa

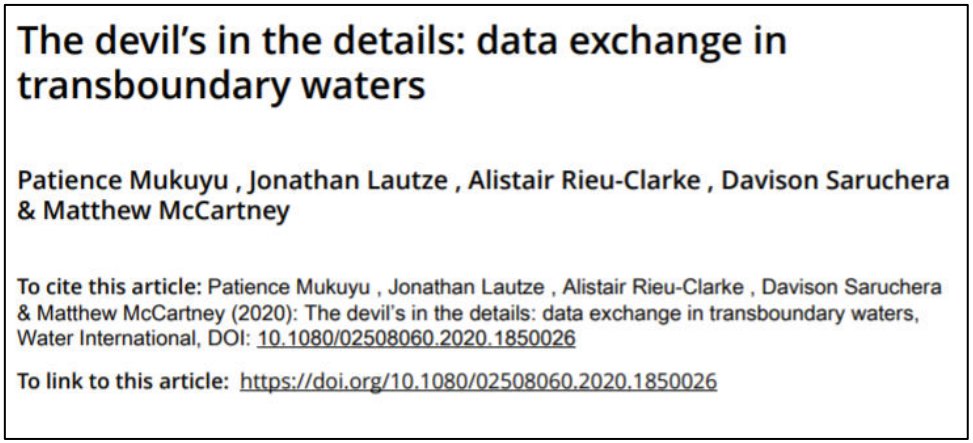
Lessons learnt

- Data sharing involves different organizations, at different levels (country level, regional/continental level, RBO level)
- International data sharing standards allow data to flow seamlessly through different platforms
- Spatial Data Infrastructure allow data providers to remain in control of their data
- Free and open-source software programs are available

- Data sharing is challenging and a never-ending effort
- A regional institution promoting data sharing is instrumental and cost-efficient (e.g. at REC or RBO level)

Protocols

Protocols certainly help but are not essential for data sharing. In most RBOs, there is no distinction between surface water and groundwater, so no need for specific mandates. **Willingness and dialog** are more important.



The devil's in the details: data exchange in transboundary waters

Patience Mukuyu , Jonathan Lautze , Alistair Rieu-Clarke , Davison Saruchera & Matthew McCartney

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"there is evidence that online platforms promote data exchange, whereas data protocols do not"

SDI have developed much over the last 15 years, in relation with the INSPIRE Directive, an EU initiative to develop SDI across the member states, to promote the flow of data and information in support of environmental policies and applications. The Directive came into force in 2007 and has been implemented gradually.

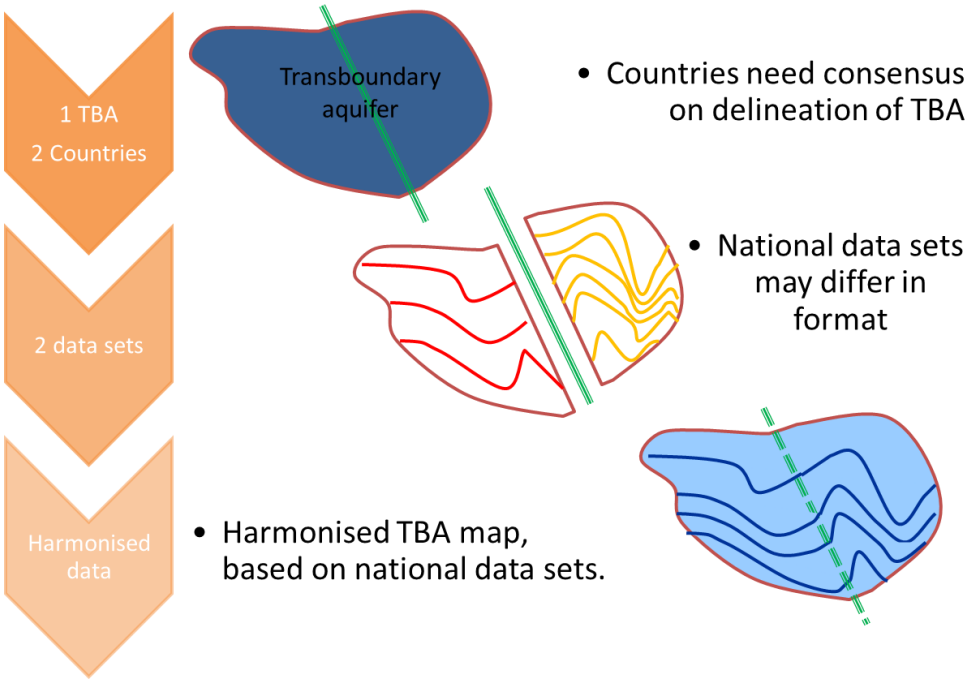
Harmonization

Data from various organisations and countries need to be harmonized. For example, datasets can be merged into one single, consistent dataset (same coordinate system, same unit)

Assessment

Data can eventually be analysed and interpreted

→ Data gaps can be identified and serve to improve the collection of data in the basin.



Data harmonization: IGRAC and UNESCO-IHP, 2015

Thank you for your attention

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United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

World Meteorological Organization

Government of The Netherlands