Upgrade of the Global Groundwater Information System (GGIS)
- Request for proposal-

1 Introduction

IGRAC is seeking a qualified software developer to upgrade (host and maintain) the Global Groundwater Information System (GGIS). If interested, you are kindly requested to submit a proposal plan and a quotation in accordance with the requirements specified in this document before the 2nd of March 2020.

IGRAC (www.un-igrac.org) is the International Groundwater Resources Assessment Centre. Since 2003, it facilitates and promotes access to groundwater knowledge to improve the assessment, development and management of groundwater resources across the world, with particular emphasis on developing countries. To support the sharing of groundwater data and information, IGRAC developed the Global Groundwater Information System (GGIS). The GGIS is an online platform containing a number of map viewers. In each map viewer, maps containing groundwater data and information can be visualized and eventually downloaded for further processing (e.g. in a GIS software). Viewers can be accessed at https://www.un-igrac.org/ggis.

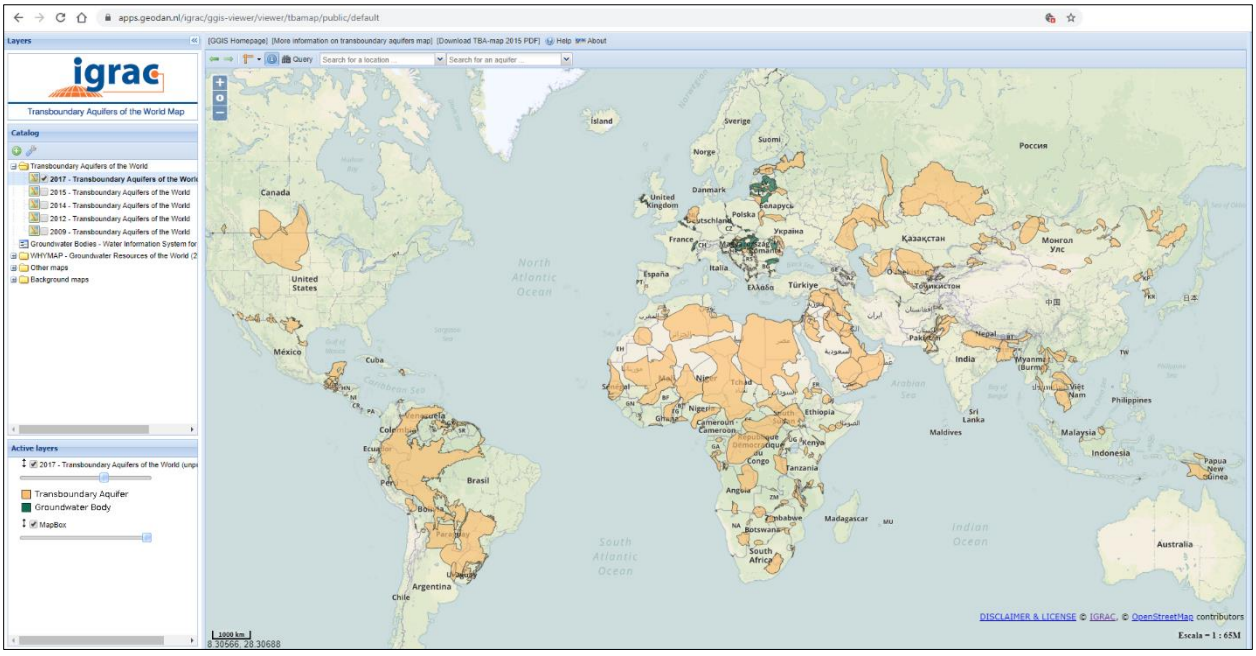

Figure 1 – Transboundary Aquifers of the World Map viewer, GGIS (accessed on 29-01-2019)

Aquifers are dynamic systems, changing in time and space. Accordingly, IGRAC is dealing (in a significant part) with spatio-temporal data, i.e. data that also has a time component. These are mostly time series from groundwater monitoring data points and maps resulting from the spatial interpretation of these data (shapefiles or tiffs). Time series data are currently shared in another software platform called the Global Groundwater Monitoring Network (GGMN) portal. The GGMN is available at https://ggmn.un-igrac.org/. Having the data split in two different systems is neither convenient nor efficient.

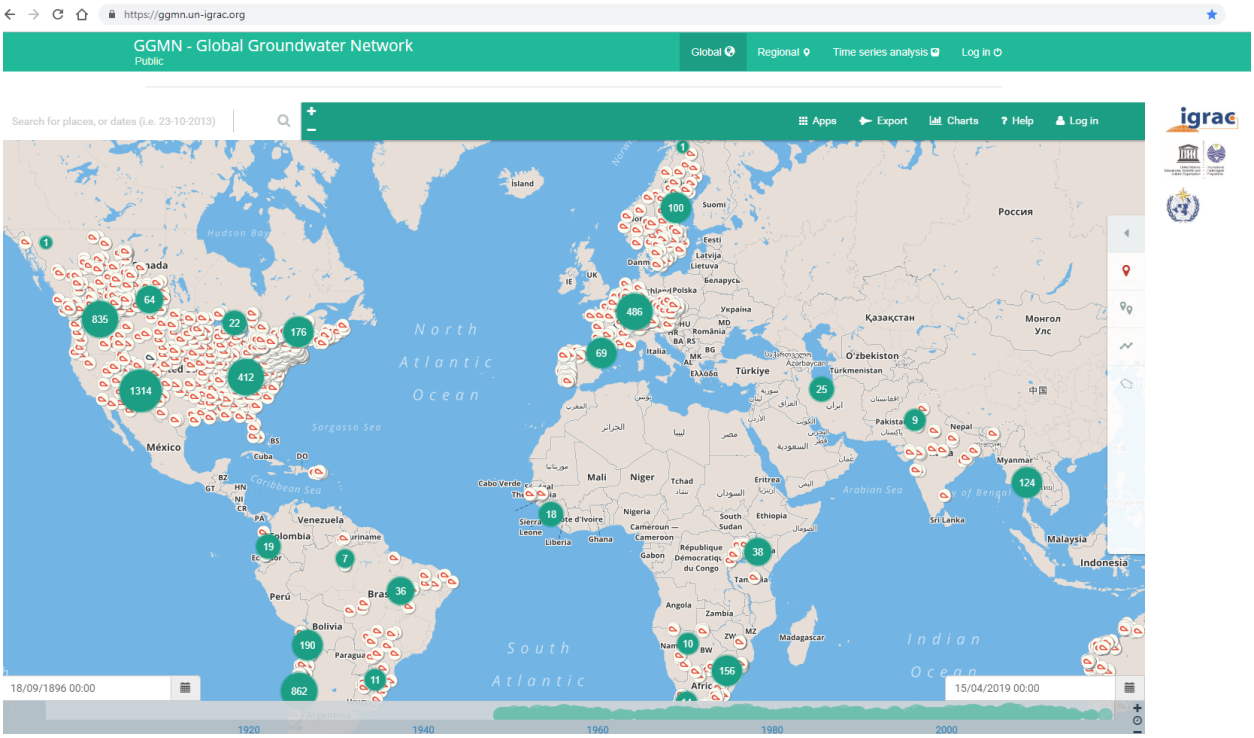

Figure 2 – The Global Groundwater Monitoring Network (GGMN) portal

Integrating all spatial and temporal data in one platform is the main reason for upgrading the GGIS. The next section describes the objectives and scope of the GGIS, as well as desired functionalities.

2 Objective and scope, desired functionalities

2.1 Viewer functionalities

GGIS is meant for users who are not necessarily GIS specialists or have high ICT skills. Therefore, data need to be available via user-friendly map viewers, where users can easily find the data layer in a layer tree, display it, consult metadata information (e.g. references) and eventually download the layer and its metadata in an appropriate format (e.g. shp, tiff or excel). A snapshot of the current GGIS map viewer is shown in Figure 3.

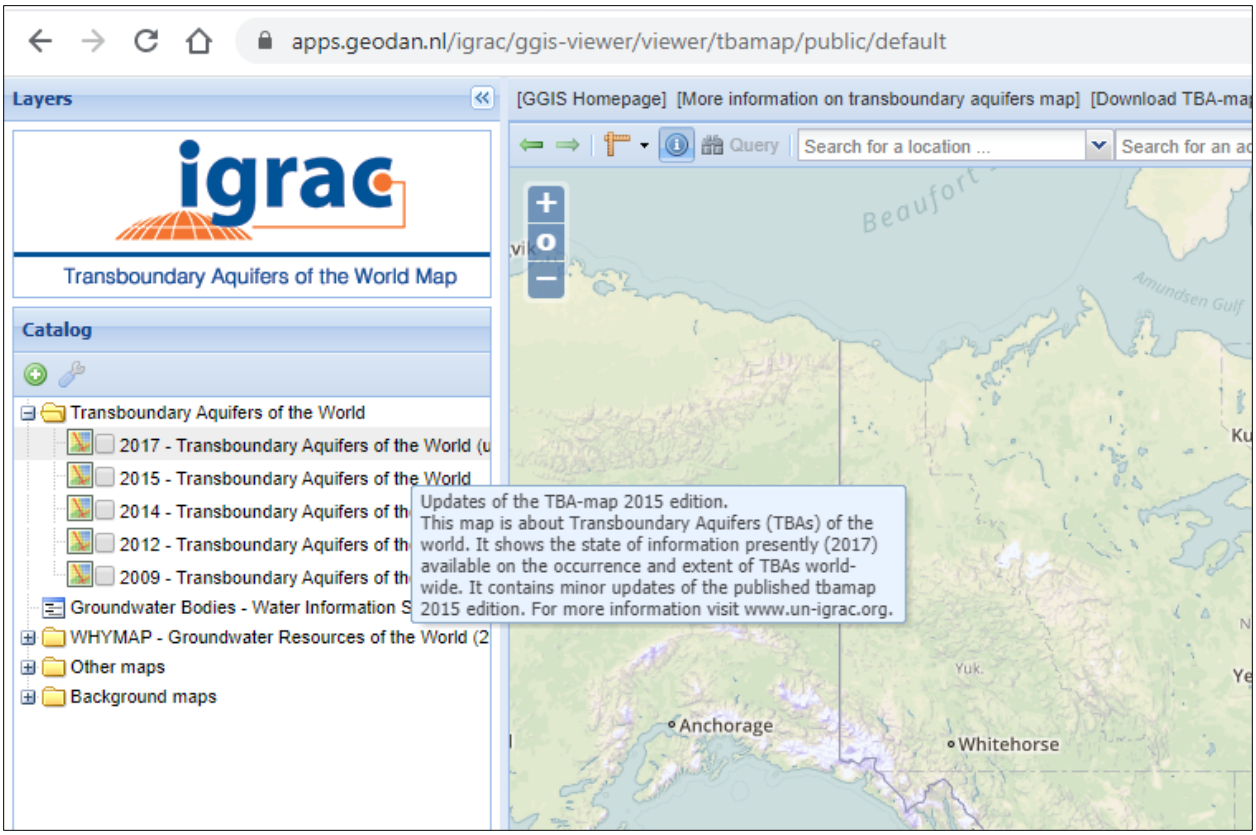

Figure 3 – The Catalog panel (at the left) shows the list of layers available for the Transboundary Aquifers of The World Map viewer in GGIS. Layers are organised in folders (Transboundary Aquifer of the World, WHYMAP, Other maps and Background maps). When hovering on a layer (in this example, hovering on 2017 – Transboundary…) a pop-up message appears revealing metadata (references) about this layer.

When clicking on features in a layer, users should be able to see their attributes (Figure 4). More functionalities would be welcome, such as the possibility to export views in pdf or image formats, or with an url, zoom-to-layers, measure distances, drawing on map, geolocation, etc.

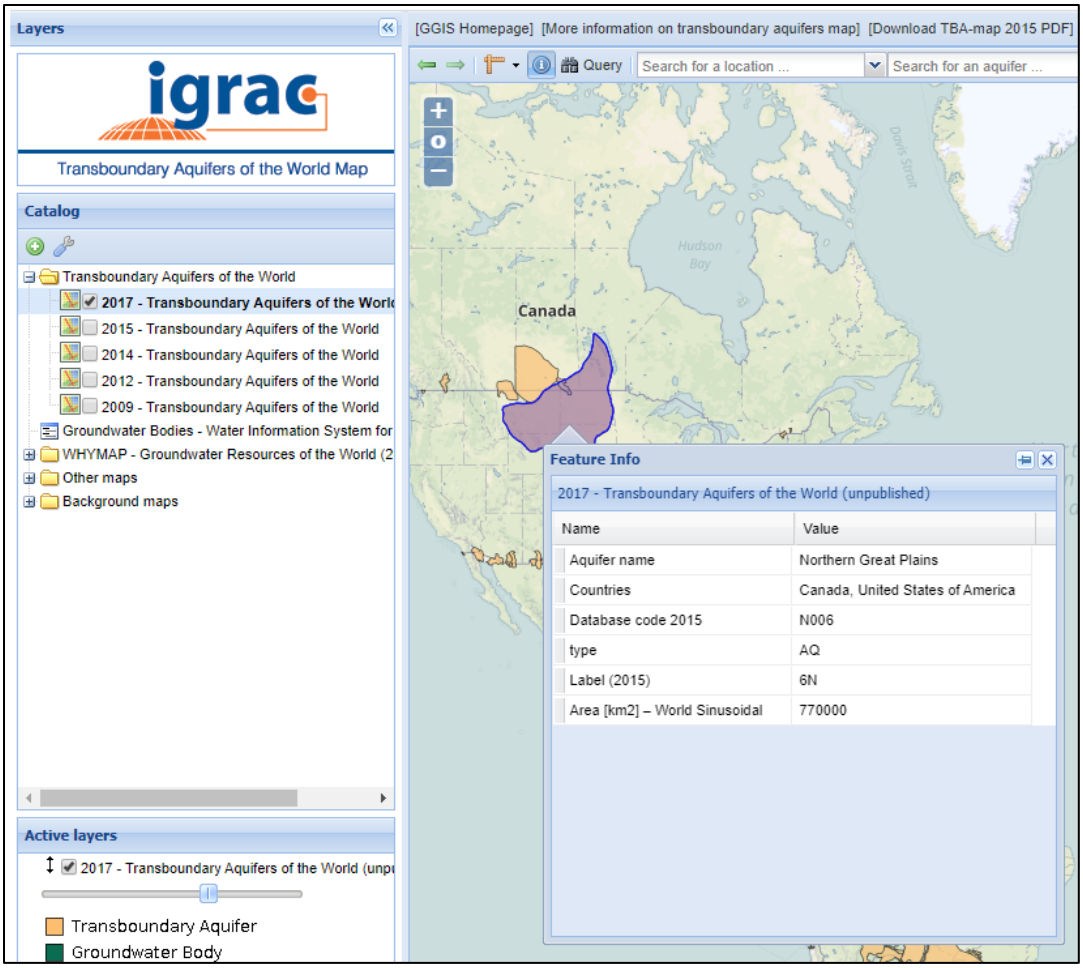

Figure 4 – When clicking on a feature (in this case, a polygon representing an aquifer shared by Canada and the US), an attribute table opens with information about: name, country, database code 2015, and more.

The possibility to access all layers in one place, for instance in a catalogue, would be an asset, even though it is expected that the map viewers will remain the main entry gates to access the data and information contained in the GGIS.

2.2 Time-series functionalities

When displaying data layers with a temporal component, two options should be available:

- Opening a window (either pop up or separate window) when clicking on a feature (for instance a monitoring station). Time series associated with that feature would be displayed in that window in one or several x-y charts (if multiple time series are associated to one monitoring station) and be available for download. Next to the chart(s), relevant data and metadata about the monitoring stations should be provided (e.g. location of the borehole, depth, stratigraphy, borehole construction). Figure 5 and Figure 6 show examples of this functionality.

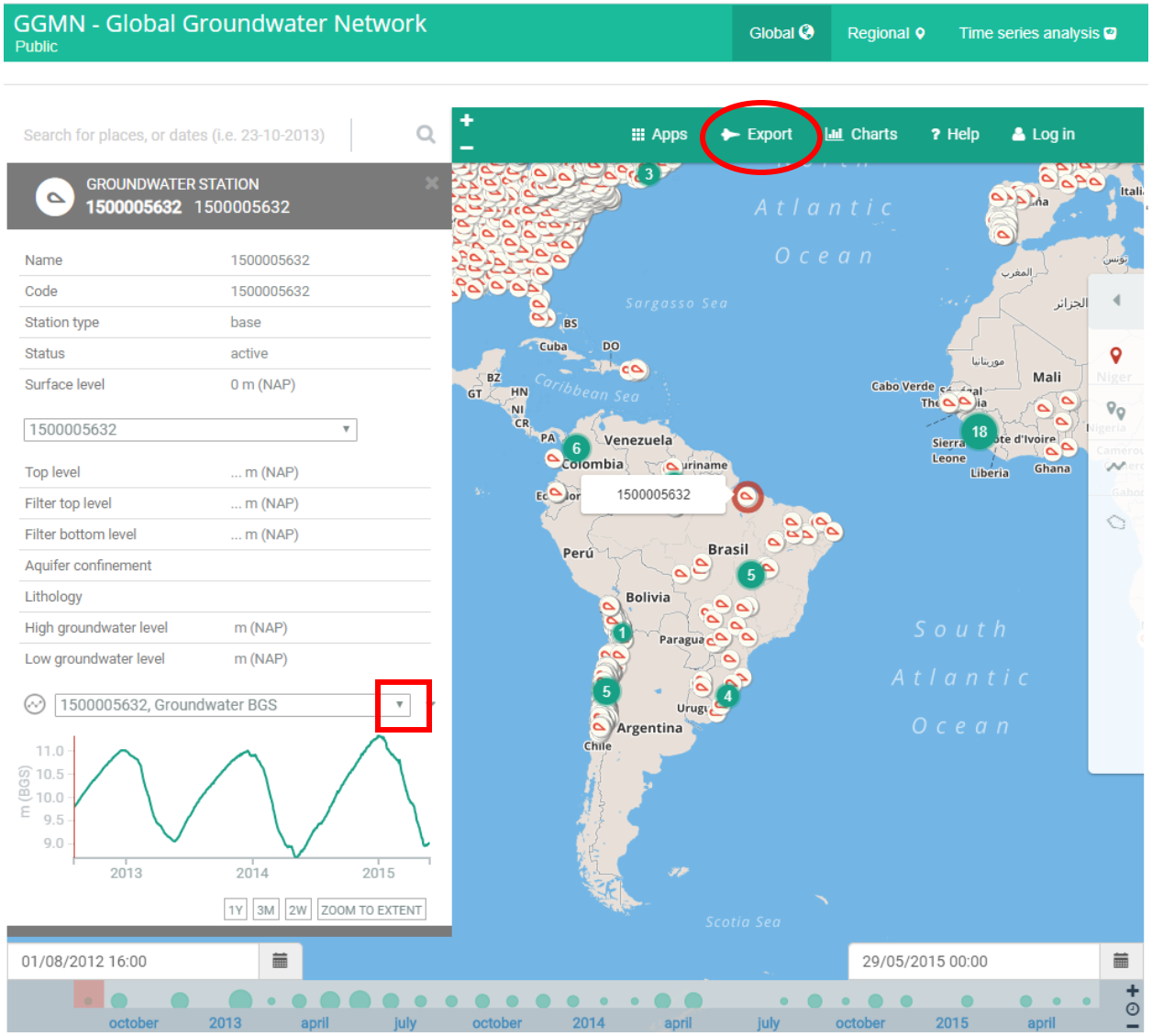

Figure 5 – In the current version of GGMN, when clicking on a monitoring well, a lateral panel opens showing a time series graphs of groundwater levels, together with other metadata (if available). Multiple time series associated with that well can be opened as well (when clicking in the button inside the red square). The time series can be downloaded (via Export) in CSV format.

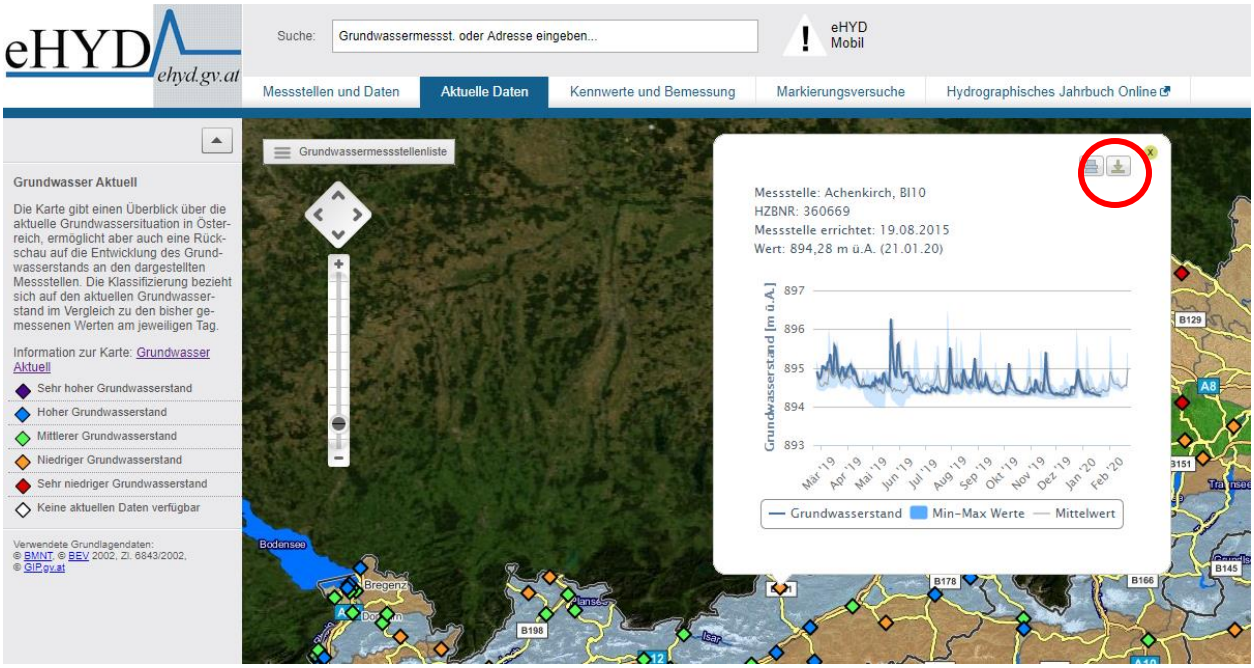

Figure 6 – Example from the eHYD platform from Austria (https://ehyd.gv.at/#). When clicking in a well, a pop-up window opens showing a time series graph of groundwater levels. The graph can be downloaded as an image when clicking in the download button (highlighted with a red circle)

IGRAC would like to have some basic time-series processing (such as trend analysis) available as well. See for example the National Groundwater Monitoring Network in the US (Figure 7) and the Groundwater Monitoring Network of the Netherlands (Figure 8).

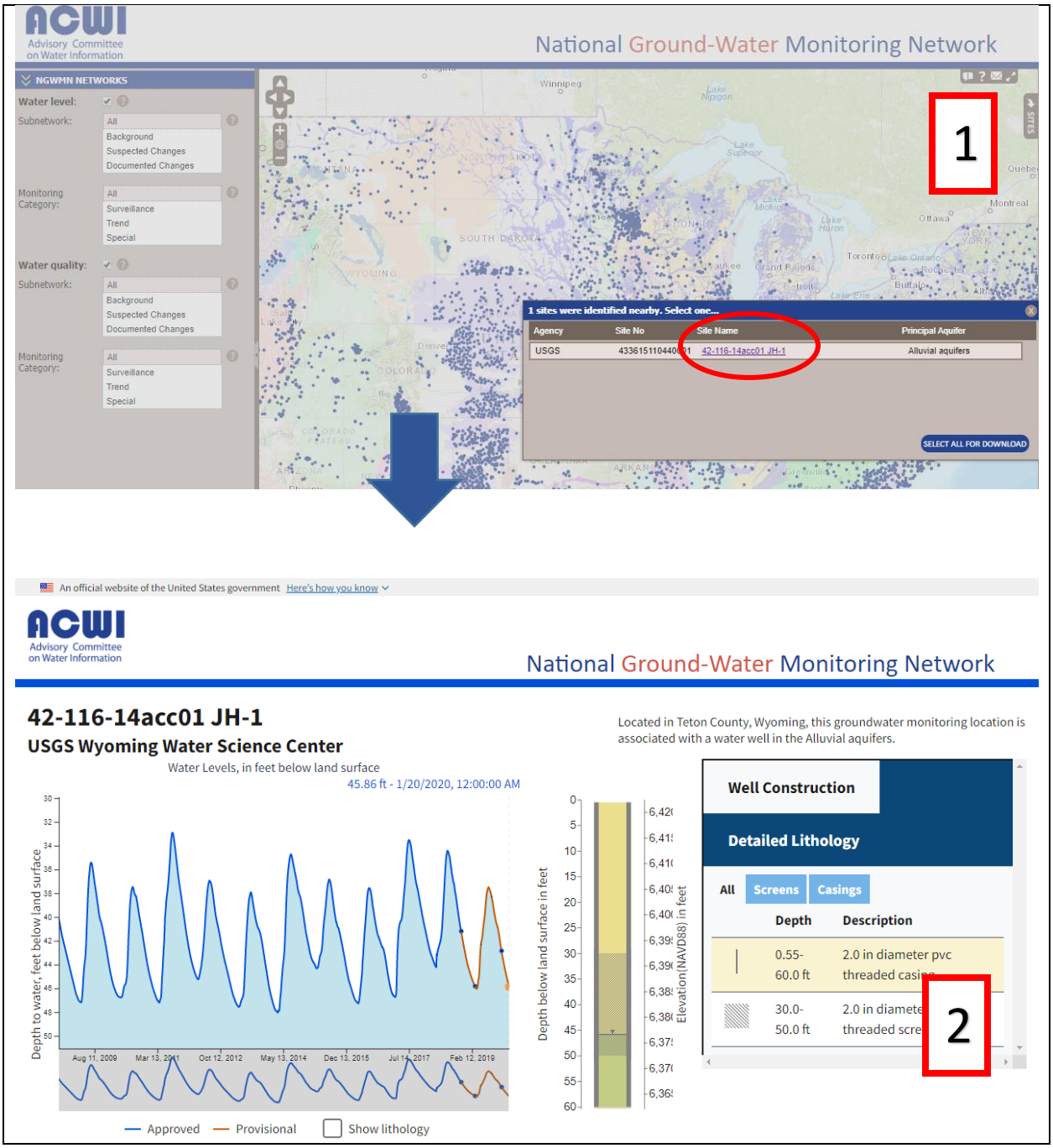

Figure 7 – A new window opens (2) after clicking in a monitoring station in the map (1), including a time series graph of groundwater levels and information on well construction (https://cida.usgs.gov/ngwmn/index.jsp)

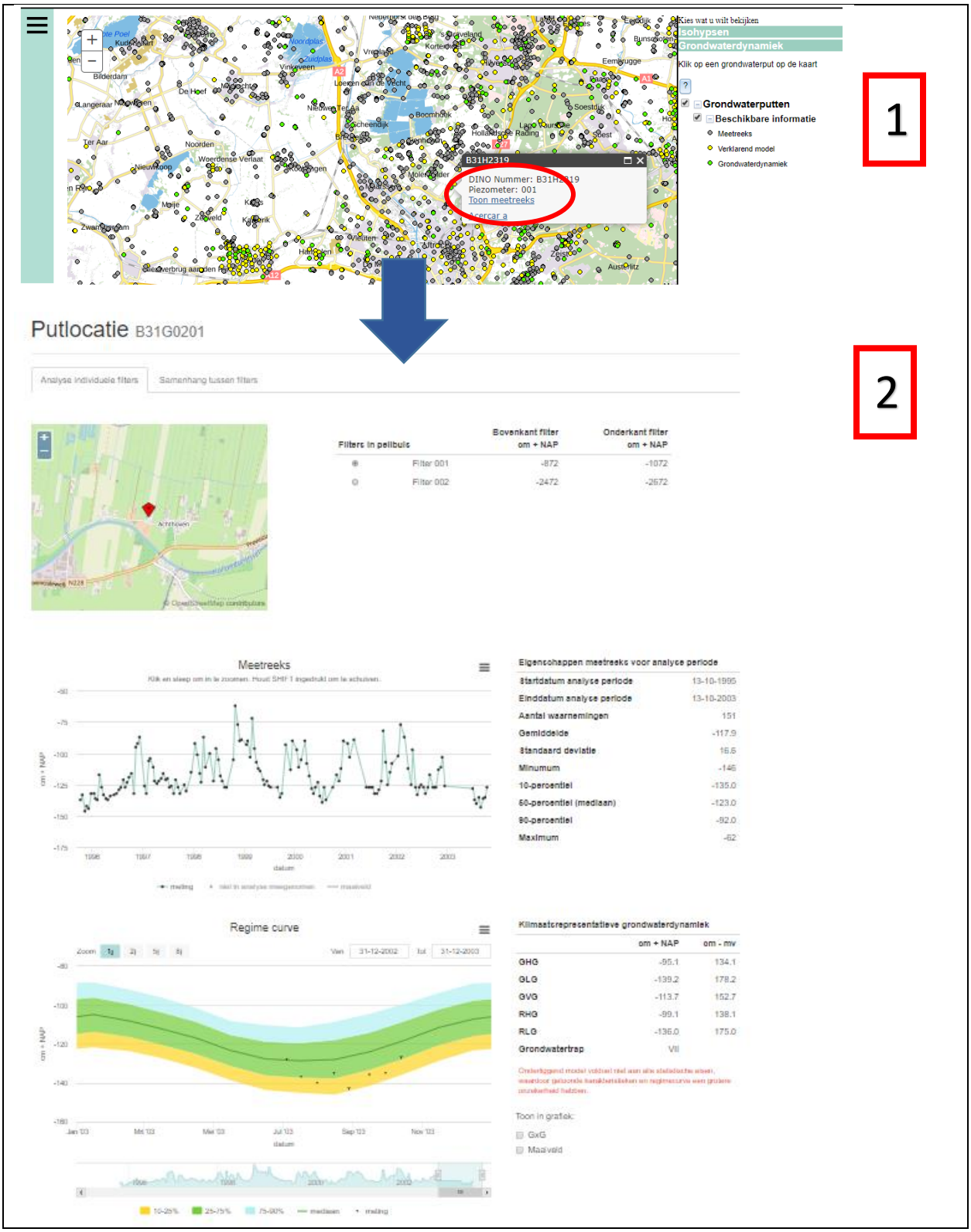

Figure 8 - A new window opens (2) after clicking in a monitoring station in the map (1), including a time series graph of groundwater levels, a mini map, selection of filters and other analyses (https://www.grondwatertools.nl/grondwatertools-viewer).

- Using a time-slider for visualizing layers at different time steps. This would be useful for browsing through time-dependent polygons or tiff images (Figure 9).

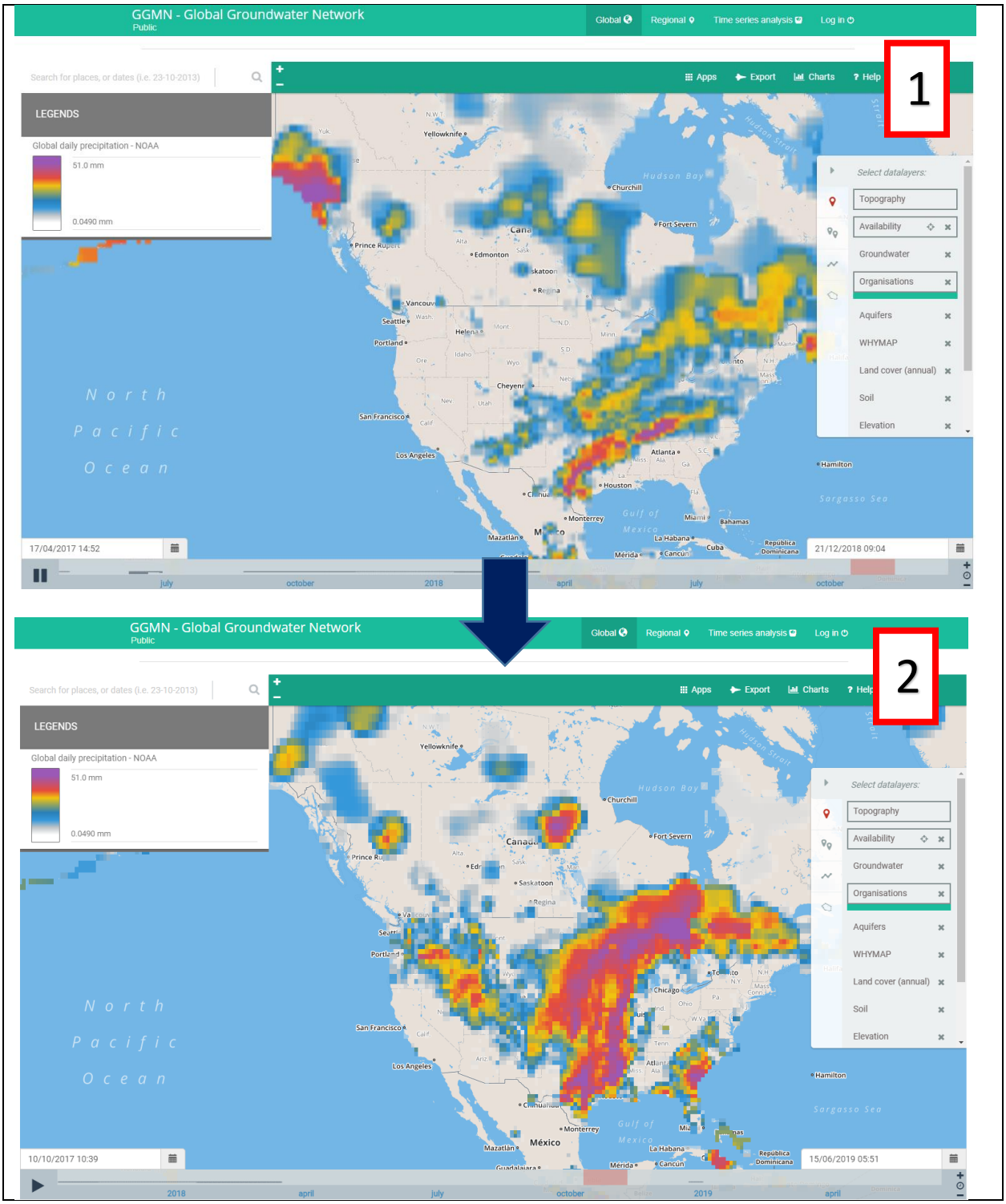

Figure 9 – Example from GGMN. Layer "Global daily precipitation – NOAA" is shown. A time slider in the bottom allows the user to see how this layer in changing in time. Ideally, the time slider should show the exact date of the layer (not available at the moment)

2.3 User roles

With the GGIS, IGRAC is supporting countries to share groundwater data and information, for example about transboundary aquifers. Currently, IGRAC provides selected partners a possibility to upload data in the GGIS and to decide who else can view and download the data. When part of a specific project, data from various partners are accessible via a dedicated project map viewer. Many partners use the GGIS because they have limited resources to develop and maintain their own groundwater data sharing system. Preferably, in order to increase ownership over a GGIS viewer, these users should be able to embed a GGIS viewer in their own website. Since many partners consider groundwater data sensitive, the GGIS should provide sufficient security to prevent unauthorised access to data.

2.4 Connection with other platforms

It is very important that the GGIS can connect with other data sharing platforms, in order to collect data from them and/or share data with them via OGC standards (e.g. WMS[1], WFS[2], SOS[3], GWML2[4]). However, some platforms don't support OGC standards but work with API. IGRAC would prefer if data retrieved from external platforms through API could be automatically uploaded in the GGIS, for instance in batch mode.

Similarly, IGRAC intends to link the GGIS platform with smartphone apps in the future, whether a dedicated GGIS app or apps developed elsewhere (e.g. mWater, Akvo Flow, FieldLogger, GoCanvas). These apps could be used for instance to collect groundwater monitoring data in the field and to send them automatically into the GGIS.

2.5 Language

As IGRAC is active internationally, it is crucial that all the GGIS is available in English. Availability of the GGIS in other languages would be an asset.

2.6 Documents database

Like for spatiotemporal data, the GGIS should contain a module for uploading/sharing documents of various formats (e.g. xlsx, pdf, word, jpg, png). These documents could be linked to specific viewers.

[1] Web Map Service
[2] Web Feature Service
[3] Sensor Observation Service
[4] GroundWater Markup Language

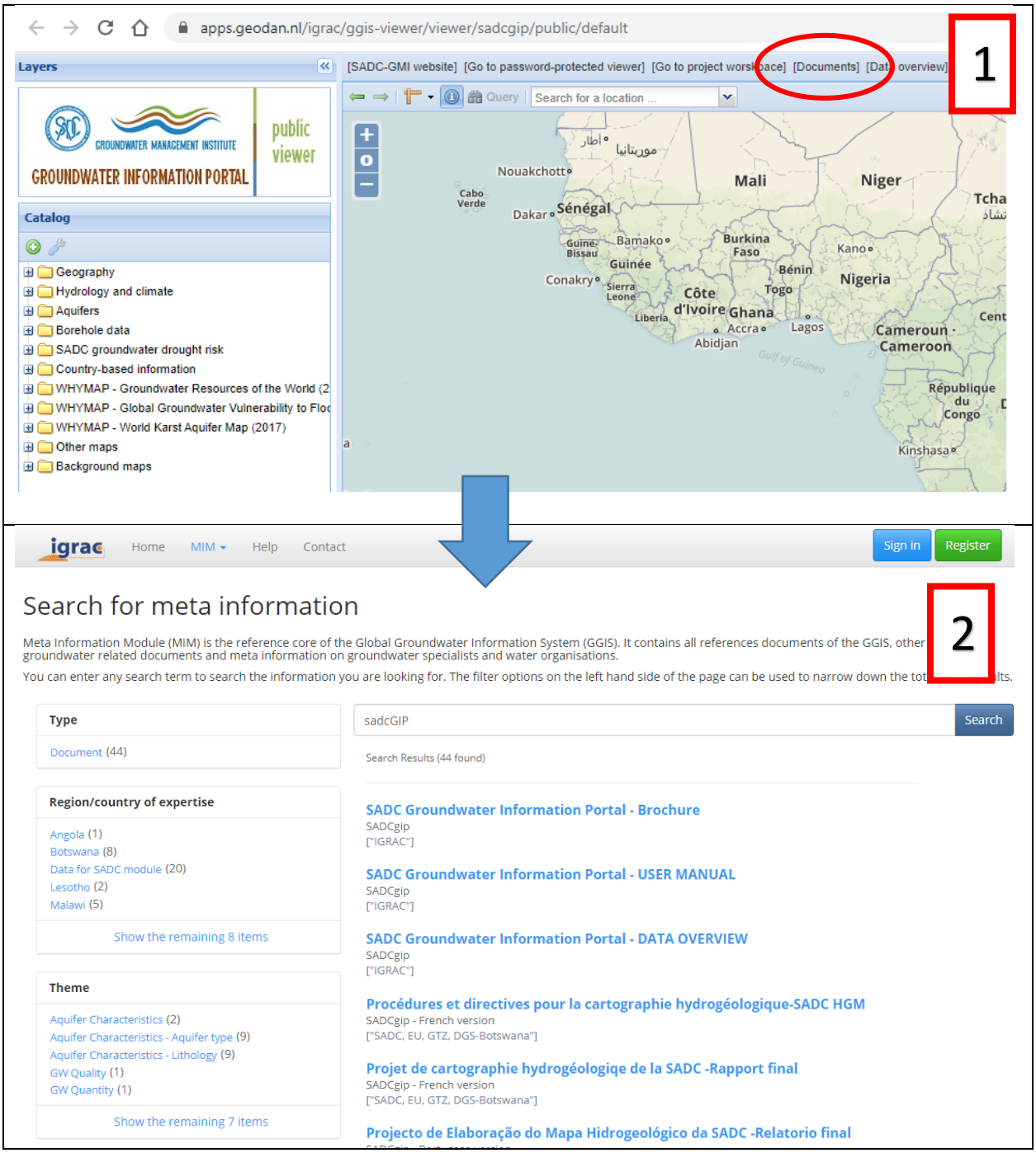

Figure 10 – Example from SADC-GIP portal (GGIS, https://apps.geodan.nl/igrac/ggis-viewer/viewer/sadcgip/public/default). The top bar contains the link to the documents database: document search is only within the database.

2.7 Control level and maintenance

Since the content of the GGIS is being updated very frequently, it is important that IGRAC has extensive control on the system. Tasks that IGRAC should be able to perform without the intervention of the GGIS developers include:

- Creation of new viewers, including setting up the layer tree
- Upload/deletion of data in the GGIS
- Connection of the GGIS with external servers (to retrieve data from other platforms)
- Management of users' roles

2.8 Use cases

2.8.1 Admin (IGRAC)

IGRAC uploads spatio-temporal data (maps and graphs) and documents related to groundwater quality (among others). IGRAC creates a map viewer where these data can be visualised publicly.

In addition, IGRAC establishes a WMS connection with the server of another organisation (for example https://www.gapmaps.org/Home/Public to retrieve maps of groundwater quality), so that data from that organisation can also be seen in the viewer. Furthermore, IGRAC makes a connection via API with an available service to receive time series of groundwater levels (for example, https://data.ca.gov/dataset/periodic-groundwater-level-measurements).

2.8.2 External users (no registration needed)

There is a public viewer (e.g. Groundwater Quality) in GGIS. External users can, without registering, access the viewer, select the layers they want to see and export the view in pdf format. They can also download the data and consult the metadata (e.g. references). Since the layer tree of the viewer displays layers from various regions of the world, the zoom-to-layer option is very useful. The documents are linked to the viewer, and vice-versa.

When clicking on a feature point (e.g. a monitoring well), a pop-up box appears on the screen showing the feature attributes (e.g. ID, name, coordinates). If there are time series associated with that feature point, users can click on a link that opens another window, where time series is visible in a x-y chart. The users can visualise several time series simultaneously.

2.8.3 Regional project partners and private data

As part of a regional project, IGRAC has given Partners A and B access to the GGIS and offered them a dedicated map viewer. Partners A and B can log in in the GGIS, where they can upload spatio-temporal data or documents. Partners A and B manage their viewer: they decide what data are available in the viewer. These can be their data but also data from other project partners who have registered in the GGIS. As Admin, IGRAC have access to all data in order to assist Partners A and B in managing their data and their map viewer. The map viewer can be embedded in Partner's websites, if required.

2.8.4 Partners of the Global Groundwater Monitoring Network

As part of the current Global Groundwater Monitoring Network (GGMN), IGRAC is collecting groundwater monitoring data from partner organisations worldwide. These data will be made available in a GGIS map viewer.

Partner Y logs in the GGIS to upload monitoring data. He can upload information on monitoring stations and time series data associated to these monitoring stations. Partner Y decides what data will be shared publicly. When logging in in the GGIS, Partner Y can easily see and eventually update his own data.

Partner W is also contributing to the GGMN but, unlike Partner Y, this organisation owns a database where data can be extracted through SOS connection. IGRAC and Partner W can set up a connection between this database and the GGIS, so that data from Partner W are made available in the GGIS automatically. In case Partner W's database didn't support SOS but provided an API, it would also be possible to make a connection with the GGIS. with some programming.

2.9 Flexibility

It is crucial that the GGIS be a flexible tool, which can be improved over the years. Technology is evolving fast and IGRAC needs are also evolving, depending on projects and collaborations. It is very likely that new developments will be wished in the future, to keep the GGIS updated. With that respect, the use of open-source software components seems very promising, as the GGIS could benefit from developments of other organisations (and these organisations could benefit from the developments supported by IGRAC).

3 Procedure

3.1 Planning

The upgraded version of the GGIS should be ready to be deployed before end of 2020. The chart below is a tentative planning for the development of the new GGIS.

	2020											
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Preparation and submission of proposal												
Final decision												
Development												
Migration of data to new GGIS + Testing and debugging												
Official launch of the new GGIS												

3.2 Content of the proposal

When submitting a proposal, please include the following information:

- A selection of relevant experience in developing similar IMS and SDI, in particular in developing systems for geospatial data and time series
- Specifications of the GGIS architecture
- Maintenance plan and services, and limitations thereof
- Workplan for the development of the new GGIS
- A breakdown of costs for development and maintenance

3.3 Additional information

Interested developers are encouraged to have a good look at the current version of GGIS: (https://www.un-igrac.org/ggis) and GGMN (https://ggmn.un-igrac.org/). IGRAC can provide GGIS and GGMN manuals, containing additional information on the systems' architecture and functionality

3.4 Contact details

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