Implementation for Geological Environment Sub-node Data Sharing of Geological Cloud 2.0

Xiaoxia Ren¹, Ming Yin¹, Mingwei Han¹, Meng Zhou¹, Mengliang Yu¹* and Zhibin Huo²

¹China Institute of Geological Environment Monitoring, Beijing, China
²Institute of Hydrology and Environmental Geology, Shijiazhuang, China

*Corresponding author email: yuml@cigem.cn

Abstract. Geological Cloud 2.0 is a comprehensive upgrade of data resources and systems on the Geological Cloud 1.0. As one of its distributed nodes, geological environment sub-node provides data sharing services in the geological environment for Geological Cloud 2.0. In order to better serve the comprehensive sharing of Geological Cloud 2.0 data resources, the specific technical implementation of Geological Cloud 2.0 geological environment sub-node data sharing was introduced with shared data. The construction effect of this node was introduced. The results show that the data sharing implementation technology of geological environment sub-node provides reference experience for Geological Cloud 2.0 construction and upgrading in the future.

Keywords: Geological cloud 2.0; Geological environment sub-node; Data sharing service; OGC; Interface.

1. Introduction

In October 2019, "Geological Cloud 2.0" was released and launched. "Geological Cloud 2.0" is the successor of "geological cloud 1.0" [1,2], it has same design concept based on cloud architecture. The biggest change in "Geological Cloud 2.0" is that we can get more and more data resources and systems from it, and it can provide much better resources and cloud services. "Geological Cloud 2.0" follows the Geological Cloud 1.0 architecture and is still distributed cloud architecture, consisting of one main central node, sub-central nodes, and backup nodes. Each node of "Geological Cloud 2.0" in this cluster is very important, so the construction of each sub-node plays an important role in the overall construction of "Geological Cloud 2.0". This article is based on the "Geological Cloud 2.0" data sharing framework, taking the "Geological Cloud 2.0" geological environment node as an example to illustrate the implementation of the data sharing technology of the geological environment node.

2. Geological Cloud 2.0 Data Sharing Framework

The "Geological Cloud 2.0" data sharing framework follows the overall architecture of "Geological Cloud 2.0" and belongs to distributed cloud architecture. The data sharing framework is shown in Figure 1.
Figure 1. Geological cloud 2.0 data sharing framework.

(1) Infrastructure-as-a-service (short for IaaS)
This layer is “Geological Cloud 2.0” infrastructure layer, which consists of 1 + N sub-nodes. One is the main central node, and the other is the sub-node. And all of them are connected to each other through IP-based connectivity to ensure the data sharing services.

(2) Data-as-a-service (short for DaaS)
This Layer provides the data services. Spatial data Map of Sub-node can publish data services according to the Open Geospatial Consortium (short for OGC) standard [3-5], and spatial data can implement data sharing interfaces to complete data sharing.

(3) Platform-as-a-service (short for PaaS)
This Layer provides a geological cloud resource framework to achieve registration, release and management of data services.

(4) Software-as-a-service (short for SaaS)
This layer involves the licensure of a data sharing application to customers through geological cloud portals, geolocation apps, and sub-centre application systems.

3. Realization of Geological Environment Node Data Sharing Service
As the Figure 1 describes, a sub-node to complete the data sharing needs to implement the data services or data sharing interfaces of this node and finishes the registering to data sharing services warehouse of the "Geological Cloud 2.0" platform service layer. The data sharing services warehouse manages all nodes' data sharing services in a unified manner. Therefore we need to confirm our data contents to share and then implement the data sharing. The details see the following.

3.1. Data Sharing Contents of Sub-node
Firstly, we tidy and organize geological environment sub-node’s data as the table 1 described. In general, all databases of geological environment sub-node located in HEE directory, and each database created a subfolder named after the database under the HEE directory. The platforms of databases have MapGIS, ArcGIS, Oracle 10g and so on. The "Geological Cloud 2.0" geological environment sub-node provides 6 new databases (sections 1-6 in Table 1) and maintains 3 big databases (sections 7-9 in Table 1).
Table 1. Databases cases for geological environment sub-node of Geological Cloud 2.0.

| Database Name                                                                 | First Level Directory | Format   |
|-------------------------------------------------------------------------------|-----------------------|----------|
| 1: 50,000 Regional Hydrogeological Spatial Database                           | HEE                   | MapGIS   |
| National Geological Resources and Environmental Carrying Capacity Evaluation Database | HEE                   | ArcGIS   |
| National Groundwater Dynamic Monitoring Database                               | HEE                   | Oracle10g|
| National Geological Hazard Survey database                                    | HEE                   | Oracle10g|
| National Mine Geological Environment Survey Database                          | HEE                   | Oracle10g, ArcGIS|
| National geological heritage and Geological Park database                     | HEE                   | Oracle10g|
| 1: 200,000 Regional Hydrogeological Spatial Database                          | HEE                   | MapGIS, ArcGIS|
| 1: 500,000 Environmental Geological Spatial Database                          | HEE                   | MapGIS   |

Secondly, we provide the data service or shared service interface of this node. It can be known from Table 1 that among the 9 major databases shared by the geological environment sub-node, the sections in the table are 1, 2, 7, 8, and 9 data are in the format of spatial data maps, and OGC-based map services are implemented. The sections in the table are 3, 4, 5, and 6 data in the database format, which implements the interface for querying and downloading spatial data. At the same time, in order to facilitate map browsing, the database format is converted to ESRI Shapefile (short for SHP), and corresponding OGC map services need to be provided.

Lastly, all data services are registered and released based on the "Geological Cloud 2.0" platform layer. When we finished data services and data sharing interfaces, we need to register them to data sharing services warehouse provided by the "Geological Cloud 2.0" platform layer. The registered content describes parameters such as the data service name, the primary and secondary directories where the data service is located, the map service URL, the map service query URL, and the map service download URL.

3.2. The Detail Implementation of Data Sharing Sub-node

As we see from the Table 1, there are only two formats database for Geological environment sub-node’s databases. One is spatial data map, the other is spatial data. So we will introduce data sharing implementation separately.

As the spatial data map, we take the National Geological Resources and Environmental Carrying Capacity Evaluation Database as an example to illustrate the realization process.

(1) we tidied and organized data preparing for data sharing.

National Geological Resources and Environmental Carrying Capacity Evaluation Database has several maps, such as National Forest Land Distribution Map, National Uninhabited Area Distribution Map and so on. Each map provides the data picture thumbnail and meta-data. As the Table 2 described, each map has a separate folder with two subfolders named "PubData" and "DownData", which is used for storing data contents such as map thumbnail and meta-data.

The organized database directory structure is shown in Table 2.
### Table 2. File Directory Structure of national geological resources and environmental carrying capacity evaluation database.

| Database Name                  | Third Level Directory | Fourth Level Directory | Data Content              |
|-------------------------------|-----------------------|------------------------|---------------------------|
| National Geological Resources and Environmental Carrying Capacity Evaluation Database |                       | PubData                | PNG\ NFDMap.png           |
| National Forest Land Distribution Map |                       | DownloadData           | NFDMap.xml                |
| National Uninhabited Area Distribution Map |                       | PubData                | PNG\NFDMap.png            |
|                                |                       | DownloadData           | NFDMap.xml                |

(2) We published data services and registered to data sharing service warehouse. The national geological resources and environmental carrying capacity evaluation database only includes spatial data map. As the section 3.1 describes, it needs to complete the OGC map service. So we published OGC Web Map Server (short for WMS) [6], for each map through ArcGIS Server 10.3 and published data services registered to data sharing services warehouse provided by the "Geological Cloud 2.0" platform layer. See Figure 2 for the parameter configuration of registration.

![Figure 2. Data sharing service registration interface.](image)

As the spatial data, we take the National Geological Disaster Survey Database as an example to illustrate the realization process. The difference from the spatial map is that it needs to implement the data sharing interfaces including query and download interfaces. Data organization and publishing
OGC WMS are same to the National Geological Resources and Environmental Carrying Capacity Evaluation Database, please see the section 3.2.

(1) We defined the spatial data query interface and download interfaces.
Spatial data query interface (abbreviated as IQ), which supports Get and Post request methods. The request parameters include the current request page, the request number, and the request geographic scope. The interface returns the result format as JSON, including ordinate, name, provider, thumbnail, download address, details address, etc.
Spatial data download interface (abbreviated as ID), which supports Get and Post request methods. The request parameter is the request geographic scope. The returned result format is JSON, including ordinate, name, provider, thumbnail, download address, detailed address, etc.

(2) And we implemented the data sharing interfaces, published the map services and registered them to data sharing service warehouse.
Spatial data of National Geological Hazard Survey Database stored in the Oracle 10g database was converted to SHP files for publishing WMS map services and providing the query and download interfaces. So we shared SHP files as the OGC WMS map services through ArcGIS 10.3 Server and implemented the data sharing interfaces as a Web-API defined in section (1), which were released through Windows IIS and could provide the required information by called IQ and ID.

4. Construction Effect
While "Geological Cloud 2.0" was released in 2019, geological environment sub-node of "Geological Cloud 2.0" provides 9 major databases including 1: 50,000 Regional Hydrogeological Spatial Database, National Geological Resources and Environmental Carrying Capacity Evaluation Database and so on. Through the Geological Cloud 2.0 portal, the logged-in users of intranet can perform operations such as browsing, querying, and downloading to realize the data sharing of geological environment sub-node. Please see the Figure 3 for construction effect.

5. Conclusion
"Geological Cloud 2.0" is a comprehensive upgrade and improvement of data resources and system functions based on the "Geological Cloud 1.0" cloud, which realizes data sharing of national core geological databases. The geological environment sub-node, as one of the “Geological Cloud 2.0” distributed nodes, provides 9 core geological databases (see Table 1) and accomplishes the data sharing by intranet. The geological environment sub-node shares the work results of geological environment in recent years and in future will provide data support for the “geological cloud 3.0” data sharing service.
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