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Deliverable D6.4
GeoViQua components integration within the GCI

Version 1.0

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<table>
<thead>
<tr>
<th>Document control page</th>
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<tbody>
<tr>
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Revision history

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<th>Date</th>
<th>Modified by</th>
<th>Comments</th>
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**Figures**

Figure 1: The GeoViQua components diagram emphasizing the server side ................................................................. 2

Figure 2: DAB-Q components integration .................................................................................................................. 4

Figure 3: How the GEO label URL is integrated into the DAB by using the BrowseGraphic and how the DAB-Q also integrates the User Feedback Server .................................................................................................................. 4

Figure 4: Combined WMS-Q response map. More difference in the triangle colours indicates more uncertainty. ................. 5

Figure 5: GEO DAB structure and its position within the GeoViQua components structure .................................................. 7

Figure 6: GEO label showing all the facets filled in but the one about user feedback .......................................................... 8

Figure 7: GEO label API documentation as shown in www.geolabel.net ........................................................................... 9

Figure 8: WMS metadata integration flow ..................................................................................................................... 11
1. Abstract

This document exposes the followed methodology for the GeoViQua service components integration between them and into the GEOSS common infrastructure. It describes the relevant work done about the interaction of the project components in the scope of the integration work package (WP6). This report also includes brief descriptions of the quality-aware developed tools. The core component of the architecture is the Discovery and Access Broker (DAB) provided by CNR that centralises the interaction of all other sever side components.

2. Introduction

This document describes the way the GeoViQua components were integrated in WP6 and tested in WP7 pilot cases activities. We enumerate the relevance of quality aware elements and tools and how they interact. The integration in the GEOSS-GCI architecture is achieved by use of a set of protocols and extensions considered and developed in GeoViQua and applied in the components, as a set of standardized services providing quality aware discovery and visualization. This deliverable complements the deliverable D8.5 “GCI technology integration strategies of the final solution report” that focuses more on the client side and the integration into the GEOSS portal mirror provided by ESA. This deliverable follows the same structure as D.7.4. “GCI pilot case perspective recommendations for enabling quality aware visualisation and search”. That one precedes this one and provides the description on how these components have been tested in the integrated testing environment GeoViQua has deployed for this purpose. In opposition, this document focuses on the server side integration and those components associated to services.

2.1 Introduction to the GeoViQua components

The server components are clearly identified in the left hand side of the following GeoViQua components UML schema shown in Figure 1.
Currently, producer and user encoding models (WP6), quality-aware queryables and geosearch linking data providers and user feedback information stored in catalogues (WP4), together with visualization tools (clients and servers) (WP5) are integrated between them and ready for its integration into the GCI. In addition, the GEO label service is part of the GeoViQua quality-aware contributions to GEOSS and can be integrated. Quality elicitation components, including intercomparison (WP3) are exemplary use cases that show the way to future components that help to generate quality indicators in the GCI.

2.2 Introduction to the GeoViQua services in relation to their WP.

GeoViQua provides a set of scientifically developed software components and services that facilitate the creation, search and visualization of quality information on Earth Observation data integrated and validated in the GEOSS Common Infrastructure.
2.2.1 WP2 User requirements

Covering the needs of both data producers and users is one of the main targets of the project. Accordingly, the scope of GeoViQua was delimited in WP2, as explained in D.2.1 “User requirements document” and D.2.2 “Technical requirements document”. User requirements have been taken into account in the development of the following work packages activities:

2.2.2 WP3 Quality elicitation

A first review of metadata elements, quality standards, quality indicators encoding in data and metadata formats can be found in D.3.1. “Metadata extraction quality component”.

In order to share the quality information a process of standardization of this information has been done. Thus, the datasets compiled in the pilot cases selection (see D.7.1. “Document pilot case studies in a standard format”) were used in the quantitative and qualitative estimation of quality indicators. Those indicators where produced for both continuous and categorical variables at dataset level and sample level (sample including pixel level as the ultimate individual measurement in raster data models and object level in vector data models). These variables are used to populate the DAB with complete metadata document records. Particular focus has been given to the use of GeoViQua thesaurus (http://QualityML.geoviqua.org/) which contains the definition of data quality parameterization concepts, in line with UncertML (http://www.uncertml.org/). More details are provided in the D.7.3 “Data quality parameterisation for the GeoViQua pilot case studies”.

In WP3 quality elicitation components have been developed (see QI emitter in the UML diagram). More details are provided in D.3.3 “Quality elicitation component for continuous and discrete valued variables” about how the GECA toolset (quality elicitation, collocation and data assimilation) has been wrapped as a WPS service and how the QI emitter uses GECA results to elaborate quality indicators that are later introduced in metadata documents stored in the GeoNetwork service that can later be harvested by the DAB. To name a few, geographic and attributes collocation, interpolation, modelling and classification processes have been considered in error estimation and validation, altogether leading to quality elicitation, uncertainty mapping and accuracy assessment reflected in quality parameterization, quality indicators and quality measures.

2.2.3 WP4 Quality search

New quality descriptions, fit for purpose dataset discovery using metadata intercomparison tools, quality labels and quality thresholds, or quality aware queriables for
geosearch capabilities have been implemented in the GeoViQua solutions, as described in D.4.2. “Smart searchable interface component report”. GeoViQua prototypes support quality-constrained queries. The main component is the Quality-enabled Discovery & Access Broker DAB-Q, an extension of the GEO-DAB for the implementation of the GeoViQua Quality Models and the CSW-ISO-PQM interface, embedding the user quality broker (associating user feedback information to query results), mapping and adaptors (e.g., conceptual mapping between WMS or SOS quality concepts and ISO ones). See Figure 2 for a diagram of the DAB integration capabilities and the place of the new quality components. Particular emphasis was done on harvesting the WMS-Q services and the inclusion of a reference to the GEO label service as a browsing graphic Figure 3.

Figure 2: DAB-Q components integration.

Figure 3: How the GEO label URL is integrated in to the DAB by using the BrowseGraphic and how the DAB-Q also integrates the User Feedback Server.
2.2.4 WP5 Quality visualization

GeoViQua visualization work package has focused on providing quality-aware services that have been presented in international standards bodies and interoperability experiments. Outcomes are described in D.5.1. "Integration of quality information with OGC visualization services best practice report". Additionally, it has been adapted to conform an OWS-9 Best Practice Report (i.e., “OWS-9 OWS Innovations Data Quality for Web Mapping Engineering Report”) and D.5.4. “Final versions of quality-aware visualization components”.

The OGC standards WMS, WMTS, and KML have been extended respectively to WMS-Q, WMTS-Q and KML-Q in order to integrate quality information, see Figure 4 for the result of one such a service. GMLCov and ARML, although briefly, have also been reviewed in GeoViQua. Capabilities and layer properties have been paid due attention. WMS-Q service capabilities description had been integrated in the DAB-Q.

![Figure 4: Combined WMS-Q response map. More difference in the triangle colours indicates more uncertainty.](image)

2.2.5 WP6 Quality integration

The modular approach that we adopted in the server side has helped to integrate the results. The main strategies to facilitate the integration were the adoption of web services architecture and the use of standard protocols (modified when necessary). When no standard protocol was available, a clean RESTful API was adopted.

A quality framework that enhances producer metadata and proposes the addition of user feedback is embedded in the GeoViQua Quality Models. The Producer Quality Model
(PQM), built as an extension over the existing standards ISO19115 and ISO19157, adds reference dataset information, citations traceability of quality statements and discovered issues. The User Quality Model (UQM) defines the database structure for a feedback server from which comments, citations, discovered issues, ratings and reports of usage may be stored and retrieved. These models are explained in D.6.1. “Data quality encoding as a best practice paper”. In the context of GEOSS, leveraging expert user feedback is an excellent opportunity to improve data quality assessment in practice, as was demonstrated in WP2 outcomes.

The link between the PQM and the UQM has been inserted in the WP4 architectural structures for GEOSS. In addition, the GEO label API is able to retrieve information from both models and generate a complete label for the dataset.

In sum, the outcomes of GeoViQua add rigorous data quality representations to state-of-the-art search and visualization in the GEO Portal functionalities of GEOSS.

As one of the main challenges is the evolution of the GEOSS architecture and GEO Portal code, GeoViQua has been forced to adopt the approach of simulating the integration of the quality aware prototypes in the current GEO Portal through a virtual machine, specific portlets and a copy of the DAB.
3. Integration of generic service components into the GCI

3.1 DAB-Q

This service plays a key role integrating the GeoViQua quality model. The service harvest metadata from catalogue and map service instances that can be used to elaborate a catalogue of datasets automatically. Additionally, it allows translating the metadata from ISO to GeoViQua quality models in both directions. The CSW requests have been adapted to support the request for both the ISO metadata model and the GeoViQua model. See Figure 5 for a description of the DAB-Q elements in relation to the other GeoViQua components.

![Figure 5: GEO DAB structure and its position within the GeoViQua components structure.](image)

This is a CSW request example that returns a ISO 19115 document:

http://geoviqua.essi-lab.eu/dabq-demo/services/cswisoq?service=CSW&request=GetRecordById&id=mtri2an1ib&elementSetName=full&format=text/xml&outputschema=http://www.isotc211.org/2005/gmd

This is a CSW request example that returns a GeoViQua document:

http://geoviqua.essi-lab.eu/dabq-demo/services/cswisoq?service=CSW&request=GetRecordById&id=mtri2an1ib&elementSetName=full&outputschema=http://www.geoviqua.org/QualityInformationModel/4.0
3.2 User feedback catalogue

This catalogue allows the users to provide information about the different datasets present on the portal. The feedback catalogue has a JavaScript API that is used by the DAB to request all the feedback items that refers to a producer metadata document instance and it links both together in a single response.

3.3 GEO label generator

The GEO label generator can be easily integrated through a script added to the webpage source code. To do it, the GEOSS portal only needs to know how to use the GEO label API that converts metadata and user feedback XML documents into an image mosaic that ends up composing the GEO label, see Figure 6. The GEO Label Service is a RESTful API that allows generating a SVG and JSON representation of the label from supplied metadata records.

![GEO label showing all the facets filled in but the one about user feedback.](image)

Figure 6: GEO label showing all the facets filled in but the one about user feedback.

This API can be summarized as the following URL template:

http://www.geolabel.net/api/v1/geolabel?metadata={ProducerMetadataRecord}&feedback={UserFeedbackItems}&format={format}&size={size}

Where:
- {ProducerMetadataRecord} is an URL pointing to the PQM in the form of an XML file
- {UserFeedbackItems} is an URL to the corresponding XML feedback resource
- {format} stands for SVG or JSON
- {size} corresponds to the output size of the GEOLabel bounding box in pixels

More documentation on how to use the service can be found on: http://www.geolabel.net/api.html (see Figure 7)
3.4 Quality Indicators emitter

The Quality Indicators emitter is a set of web-based services to compute and validate quality indicators for continuously-valued data using reference values. The service is compound by a backend Java API that bridges a computation MATLAB routine. This backend accepts the input of a GECA report as a ZIP file or a CSV file provided by the user or it is able to connect with the GECA WPS directly and automatically get the intercomparison result. The outputs of the quality indicator emitter report are interactive statistics/graphs and a GeoViQua-compliant metadata.

4. Integration of the providers components into the GCI

4.1 Catalogue instances

Catalogue interfaces can be integrated into the DAB-Q as harvested catalogues or as federated catalogues. This is the main functionality of the DAB and this functionality has been extended to support the GeoViQua quality model. CSW catalogues can be connected to the DAB.

4.2 Web accessible folders

A web accessible folder is a very simple way to include a short set of metadata documents into the DAB without the need to have a catalogue. This is based in the capability of most web servers (such as IIS or apache) to expose the content of a folder as an output similar to the result of a “ls” operation in a unix console or in a ftp client interface. The files found
in the folder can be harvested by the DAB. The new DAB-Q developed in the GeoViQua project supports files using the extended format of the GeoViQua Quality Model.

4.3 WMS-Q instances

The WMS-Qs are Web Map Services following the standard defined by the OGC which are aware that some of its layers describe quality parameters of certain variables. Thus, instead of each layer corresponding to one variable like in regular WMS, in WMS-Q some layers are just statistical descriptors that inform about the quality and ensemble describe one variable.

These instances are connected to the DAB-Q from where the portal is able to gather them. Each server is presented in the DAB as a metadata record for the services plus a number of metadata records corresponding to each of its served datasets (each dataset is compound of different variables which at same time are described by different quality components). The DAB-Q does not generate a record for each uncertainty component but just for the dataset level layers.

WMS-Q conventions are described in the OGC Public Engineering Report 12-160r1 “OWS 9 Data Quality and Web Mapping Engineering Report” but some problems and details were found in the implementation phase and a new version of this ER was released by GeoViQua. Details on the identification of pixel level layers and how the description of these layers can be converted into ISO metadata descriptions in the DAB can be seen in the Extra deliverable WMS-Q version 2.0 that will be included as an attachment to the second project report and also included in the GeoViQua website.

It is worth to note that WMS-Q also recommends the use of MetadataURL as a way to expose the dataset level metadata. This way a WMS service can act as a small metadata catalogue for providers that do not want to expose their catalogue (see figure Figure 8).
4.4 KML-Q instances

Currently there is no OGC standard service to generate KML documents. Since KML are mainly features, a WFS could be the used as an option. Nevertheless since KML is intended for visualization (as stated in the OGC References framework), a WMS that generates KML is also a logical alternative. The later was the route followed by GeoViQua to profit the already existent WMS. KML-Q files are integrated in the GeoViQua general architecture as a WMS-Q service able to generate KML as output format. This way the same connector developed in the DAB-Q to integrate the WMS-Q is used to integrate KML in the discovery phase. In the visualization phase, the KML is served as a result of a GetMap operation to the WMS.
5. Integration of the client components into the GCI

5.1 Metadata comparison
The metadata comparison XSLT can be applied directly to the record metadata collection produced as a result of a GetRecords or a GetRecordById operations in the DAB-Q. No additional server component is required.

Have a look to document D8.5, chapter “Integration of the client components into the GEOSS Portal” for information on how this component works in the client side.

5.2 Rubric-Q
The rubric-Q XSLT can be applied directly to a record metadata produced as a result of a GetRecords or a GetRecordById operations in the DAB-Q. No additional server component is required.

Have a look to document D8.5, chapter “Integration of the client components into the GEOSS Portal” for information on how this component works in the client side.

5.3 Provencance
The provenance XSLT can be applied directly to a record metadata produced as a result of a GetRecords or a GetRecordById operations in the DAB-Q. No additional server component is required.

Have a look to document D8.5, chapter “Integration of the client components into the GEOSS Portal” for information on how this component works in the client side.

5.4 WMS-Q Server Facade for Greenland
The WMS-Q Server Facade is implemented as a development help for the WMS-Q Web Client Greenland developed within the project GeoViQua. It allows annotating the capabilities document of any WMS server with keywords according to the WMS-Q specification, effectively telling a user/client software which layer contains which information, for example data values, standard deviation, or variance.

The server facade is intended for testing and development. Therefore it did not undergo testing of stability or any user studies and should be seen as software in an "alpha" state.

More information here:
6. Conclusions

Throughout the document procedures on how to integrate the GeoViQua developments in the GEOSS Common Infrastructure have been exposed.

Some services developed need to be incorporated directly into the GCI such as the User feedback service and the GEO Label generator. Others need to be included by the producers as components in their servers such as the CSW-Q (GEONetwork) or the KML-Q generation, and others are just conventions that need to be adopted by producers such as the WMS-Q. All these services are to be integrated into the DAB-Q. The access to those services by clients is described in the D8.5 “GCI technology integration strategies of the final solution report”.

https://wiki.52north.org/bin/view/Geostatistics/WMSQServerFacade
Annex 1

This annex contains a list of the URLs for most of the components (services or clients) developed in the GeoViQua project:

Services:

- CSW-Q interface
  - [http://dab-q.geoviqua.org/gvq-demo/services/cswisogvq?service=CSW&version=2.0.2&request=GetCapabilities](http://dab-q.geoviqua.org/gvq-demo/services/cswisogvq?service=CSW&version=2.0.2&request=GetCapabilities)

- UREAD WMS-Q service
  - [http://lovejoy.nerc-essc.ac.uk:8080/edal-ncwms](http://lovejoy.nerc-essc.ac.uk:8080/edal-ncwms)

- WMS-Q service from CREAF
  - [http://rmmwms-q.geoviqua.org/cgi-bin/GeoViQUA/WMSQ/MiraMon.cgi?](http://rmmwms-q.geoviqua.org/cgi-bin/GeoViQUA/WMSQ/MiraMon.cgi?)

- WMS Carbon CEA

- WMS-Q KML

- User feedback
  - [http://geoviqua.stcorp.nl/devel/api/v1](http://geoviqua.stcorp.nl/devel/api/v1)
  - [http://geoviqua.stcorp.nl/api/v1](http://geoviqua.stcorp.nl/api/v1)

- GEO label services
  - [http://www.geolabel.net](http://www.geolabel.net)
  - [http://geoviqua.dev.52north.org/glbservice/api/svg and](http://geoviqua.dev.52north.org/glbservice/api/svg)

- WAF folder
  - [http://essi-lab.eu/gvq/waf](http://essi-lab.eu/gvq/waf)

Clients:

- GeoPortal Mirror:
  - [http://geoportal.geoviqua.org](http://geoportal.geoviqua.org)
  - [http://scgeoviqua.sapienzaconsulting.com](http://scgeoviqua.sapienzaconsulting.com)

- DAB-Q demo portal
  - [http://geoviqua.essi-lab.eu/dabq-demo](http://geoviqua.essi-lab.eu/dabq-demo)
- [http://dab-q.geoviqua.org/gvq-demo/gi-portal](http://dab-q.geoviqua.org/gvq-demo/gi-portal)

- **GreenLand:**
  - [http://greenland.geoviqua.org/greenland](http://greenland.geoviqua.org/greenland)
  - [http://geoviqua.dev.52north.org/greenland](http://geoviqua.dev.52north.org/greenland)

- **CREAF WMS-Q client:**
  - [http://wms-q-demo.geoviqua.org/geoviqua/wmsq](http://wms-q-demo.geoviqua.org/geoviqua/wmsq)
  - [http://www.ogc.uab.es/geoviqua/wmsq](http://www.ogc.uab.es/geoviqua/wmsq)

- **User feedback**
  - [http://feedback.geoviqua.org/submit_feedback.html](http://feedback.geoviqua.org/submit_feedback.html)
  - [https://geoviqua.stcorp.nl/submit_feedback.html](https://geoviqua.stcorp.nl/submit_feedback.html)

- **GEO label services**
  - [http://www.geolabel.net/demo.html](http://www.geolabel.net/demo.html)
Annex 2

This annex contains a list of the URLs for the public documentation and auxiliary files developed in the GeoViQua project:

- **DAB-Q CSW, GI-CAT (CNR) description and code**

- **GEO label services, API and code (ASTON+52N)**
  - [http://www.geolabel.net/api.html](http://www.geolabel.net/api.html)
  - [http://twiki.geoviqua.org/twiki/bin/view/GEO_SIF/SifGeoLabel](http://twiki.geoviqua.org/twiki/bin/view/GEO_SIF/SifGeoLabel)
  - [https://github.com/lushv/geolabel-service](https://github.com/lushv/geolabel-service)

- **WMS-Q, WMS, ncWMS, (UREAD)**
  - [http://ncwms.geoviqua.org/godiva2.html](http://ncwms.geoviqua.org/godiva2.html)

- **KML-Q, KML, code. Fraunhofer(FRAUN)**
  - [https://github.com/igd-geo/pcolor](https://github.com/igd-geo/pcolor)

- **GeoNetwork plugin (ASTON)**
  - [https://github.com/GeoViQua/geoviqua-geonetwork-plugin](https://github.com/GeoViQua/geoviqua-geonetwork-plugin)
  - For Geonetwork 2.8 use the 2.8.x-dev branch

- **User FeedBack system (S&T)**
  - [https://github.com/GeoViQua/geo-userfeedback](https://github.com/GeoViQua/geo-userfeedback)
  - [http://geoviqua.stcorp.nl/home.html](http://geoviqua.stcorp.nl/home.html)

- **Q emitter tool API, (ASTON+S&T)**
  - [https://github.com/GeoViQua/computeqi-web](https://github.com/GeoViQua/computeqi-web)
  - [https://github.com/GeoViQua/emulatorization-api](https://github.com/GeoViQua/emulatorization-api)

- **GECAaaS WPS (S&T)**
  - Contact S&T

- **Schemas (ASTON)**
  - [http://schemas.geoviqua.org](http://schemas.geoviqua.org)

- **Extended quality vocabulary (CREAF-UAB)**
  - [http://qualityml.geoviqua.org](http://qualityml.geoviqua.org)

- **Tutorial (ASTON)**
  - [http://tutorial.geoviqua.org](http://tutorial.geoviqua.org)
  - [http://uncertgeo.aston.ac.uk/INSPIRetutorial](http://uncertgeo.aston.ac.uk/INSPIRetutorial)