EU4ENVIRONMENT / OUTPUT 2.4

“OPEN DATA AND CITIZENS’ PARTICIPATION IN DATA COLLECTION AND ANALYSIS”

Final report

EU4ENVIRONMENT / OUTPUT 24

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Final report

EU4Environment in Eastern Partner Countries:
Water Resources and Environmental Data (ENI/2021/425-550)

ABOUT THIS REPORT

AUTHORS(S)

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ABOUT EU4ENVIRONMENT – WATER RESOURCES AND ENVIRONMENTAL DATA

This Programme aims at improving people's wellbeing in EU's Eastern Partner Countries and enabling their green transformation in line with the European Green Deal and the Sustainable Development Goals (SDGs). The programme's activities are clustered around two specific objectives: 1) support a more sustainable use of water resources and 2) improve the use of sound environmental data and their availability for policy-makers and citizens. It ensures continuity of the Shared Environmental Information System Phase II and the EU Water Initiative Plus for Eastern Partnership programmes.

The programme is implemented by five Partner organisations: Environment Agency Austria (UBA), Austrian Development Agency (ADA), International Office for Water (OiEau) (France), Organisation for Economic Co-operation and Development (OECD), United Nations Economic Commission for Europe (UNECE). The programme is principally funded by the European Union and co-funded by the Austrian Development Cooperation and the French Artois-Picardie Water Agency based on a budget of EUR 12,75 million (EUR 12 million EU contribution). The implementation period is 2021-2024.

https://eu4waterdata.eu

IMPRINT

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1090 Vienna, Austria	75008 Paris, FRANCE

March 2025

CONTENTS

List of abbreviations

EaP ..... Eastern Partners
EC ..... European Commission
EU ..... European Union
EUWI+ ..... European Union Water Initiative Plus
INBO ..... International Network of Basin Organisations
IOW/OIEau ..... International Office for Water, France
IWRM ..... Integrated Water Resources Management
NFP ..... National Focal Point
NGOs ..... Non-Governmental Organisations
NPD ..... National Policy Dialogue
OECD ..... Organisation for Economic Cooperation and Development
ToR ..... Terms of References
UBA ..... Umweltbundesamt GmbH, Environment Agency Austria

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Executive Summary

The EU4Environment Water and Data programme, funded by the European Union and implemented by the United Nations Economic Commission for Europe (UNECE) and the Organization for Economic Co-operation and Development (OECD), supports Armenia, Azerbaijan, Georgia, the Republic of Moldova, and Ukraine in aligning their water and environmental management practices with EU standards.

The programme operated under two interconnected components: **Water Resources Management** and **Environmental Data and Information**.

This report provides an overview of the programme's progress and results under Output 24, entitled "**Open data and citizens' participation in data collection and analysis are further operationalised"**, which focuses on enhancing data accessibility, environmental governance, and integrated water resources management in the Eastern Partnership (EaP) countries.

Chapter 2 of the report details the strategic objectives, context, and implemented methodology of Output 2.4 in order to strengthen open data ecosystems and fostering citizen engagement in environmental data collection and analysis across Eastern Partnership (EaP) countries, reminding that:

- This output particularly aimed to support access to the environmental data through national open data platforms, promote citizen involvement in data collection and reuse, and align data practices with European Union directives, notably the Open Data Directive and the INSPIRE Directive. The initiative adopted the FAIR principles—ensuring data is Findable, Accessible, Interoperable, and Reusable—to foster long-term usability of environmental information.
- The national road maps developed by a previous ENI SEIS project completed by an initial country-level diagnostics to assess legal, institutional, and technical capacities, guided the design of tailored actions, such as strengthening legal and policy frameworks, supporting the production of metadata, and enhancing the visibility and usability of environmental datasets.
- Concrete outputs included the creation of national metadata catalogues, prototypes of web portals for environmental data visualization, and demonstration platforms integrating various types of data and services (e.g., FTP storage, interactive dashboards, and WMS/WFS services). Additionally, APIs were developed and embedded into existing national information systems to facilitate secure and automated data sharing between stakeholders.
- To promote innovation and participatory engagement, hackathons were organized, particularly targeting students and young professionals. These events demonstrated the practical applications of open data and showcased how public environmental data can be used to develop new services and tools for decision-makers and the broader public.

Chapter 3 provides a country-by-country overview of how the EU4Environment Water and Data programme has been implemented across the five Eastern Partnership countries—Armenia, Azerbaijan, Georgia, the Republic of Moldova, and Ukraine. Tailored activities in each country

reflect national priorities while advancing shared regional goals in environmental data and water governance.

It shows how through technical assistance, stakeholder consultations, and targeted training, the programme supported institutional development and built national capacities for environmental data management. These efforts contribute to more resilient, transparent, and EU-aligned water governance frameworks across the region.

Chapter 4 presents a country-specific synthesis of progress achieved and tailored recommendations to enhance environmental data management in the Eastern Partnership (EaP) countries. Building on a shared long-term vision, the chapter outlines key actions required to strengthen institutional frameworks, reinforce data infrastructure, and improve accessibility and interoperability of water-related data across Armenia, Azerbaijan, Moldova, Georgia, and Ukraine.

In **Armenia**, efforts should focus on establishing an inter-institutional water data governance framework linked to the national e-government portal, enhancing the Ecoportal as the main entry point for data access, completing the transfer of platform components to national servers, producing additional metadata, integrating APIs to reinforce information systems, and supporting national and international reporting processes.
In **Azerbaijan**, priority actions could include developing a national water data governance framework aligned with the open data portal, promoting the Ekoportal as a centralized access point, finalizing platform transfers, improving metadata generation, enabling API-based data sharing for hydrological and surface water quality data, and contributing to reporting obligations.
In **Moldova**, the focus is recommended on conceptualizing and developing the integrated environmental information system (IEIS), launching a pilot web portal, finalizing the transfer of data platforms, producing complementary metadata, and ensuring interoperability of hydrological and groundwater data systems via APIs.
For **Georgia**, it is recommended to promote inter-agency water data governance, develop a centralized data portal, complete platform transfers, support metadata development, enable API connectivity for NEA-managed datasets, leverage satellite imagery for water quality monitoring, and reinforce reporting mechanisms.
In **Ukraine**, key next steps include formalizing a multi-agency water data governance structure, developing a national data access portal, enriching metadata repositories, enabling API-based access for water quality monitoring systems, utilizing satellite data to complement surface water quality datasets, and supporting reporting obligations at the European level.

This chapter emphasizes harmonized, interoperable, and citizen-accessible systems grounded in FAIR data principles, with tailored pathways based on national priorities and institutional maturity.

Overall, Output 2.4 of this EU4Environment Water and Data programme played a catalytic role in operationalizing open data principles, fostering cross-sector collaboration, and laying the foundations for more transparent and participatory environmental data ecosystems at the level of the Eastern Partnership (EaP) countries.

1. Introduction

Water data management plays a crucial role in environmental protection, policy-making, and resource management. As climate change and urbanization continue to impact water resources, reliable data systems become essential for sustainable governance.

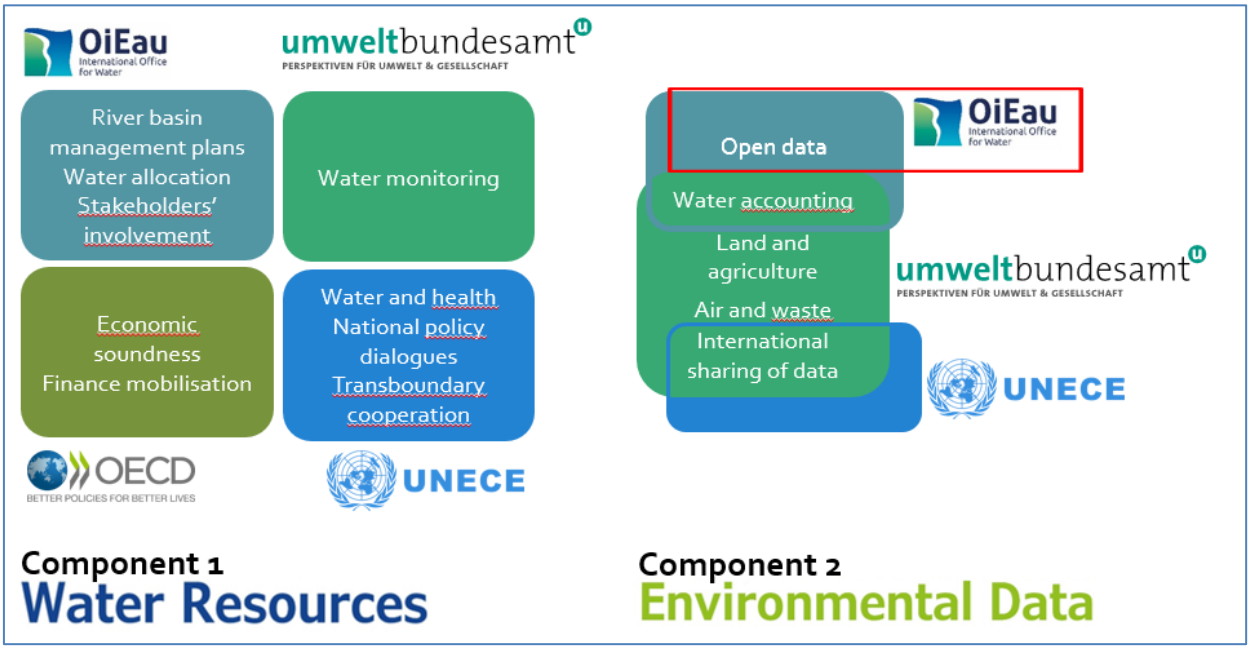


Figure 1: Components of the EU4Environment programme

This is why, as described in scheme above, the EU4Environment Water and Data Management project included a specific component C2 on environmental data aiming "to insure greater availability of policy relevant data for decision makers and citizens".

This component 2 included on its part a specific output called "open data" aiming that "**Open data and citizens' participation in data collection and analysis are further operationalized**"

This output 2.4 was initially defined with the following activities & planned results:

- Facilitating implementation of roadmaps related to e-government and open data initiatives and environmental information management and sharing
- Continuing work on metadata related to environmental data
- Integrating environmental data into open government portals
- Enabling better participation of citizens in data collection and analysis
- Gradually implementing the annual preparation of the open data maturity reports with a focus on the environment

This report provides a summary of the methodologies employed, main achievements, and key recommendations for future improvements within the framework of the EU4Green initiative.

2. Global objectives context and methodology

2.1. Remind of the output 2.4 objectives

EU4Environment /Output 2.4 entitled "**Open data and citizens' participation in data collection and analysis are further operationalised"** aimed to enhance the availability, accessibility, and interoperability of water-related data across multiple partners in each country.

The planned activities included the following:

- Facilitating implementation of roadmaps related to e-government and open data initiatives and environmental information management and sharing
- Continuing work on metadata related to environmental data
- Integrating environmental data into open government portals
- Enabling better participation of citizens in data collection and analysis
- Gradually implementing the annual preparation of the open data maturity reports with a focus on the environment

The specific objectives included:

- Facilitating the integration of environmental data into open government portals.
- Enabling better participation of citizens in data collection and analysis.
- Supporting the preparation of annual open data maturity reports.
- Ensuring compliance with European water management frameworks.

The implementation strategy involved:

- Conducting country-specific diagnostics on data management.
- Mapping legal and institutional frameworks for environmental data.
- Developing metadata catalogs and open data portals.
- Enhancing national water information systems through API integration.
- Organizing workshops and hackathons to foster citizen participation.
- Engaging with international partners to improve cross-border data exchange.

The initiative applied the FAIR (Findable, Accessible, Interoperable, and Reusable) data principles to ensure long-term usability and integration of water-related data.

2.1. Elements of context

2.1.1. Main European Directives related to data to be considered

Two (2) main European directives related to data management have particularly to be considered in relation to data management.

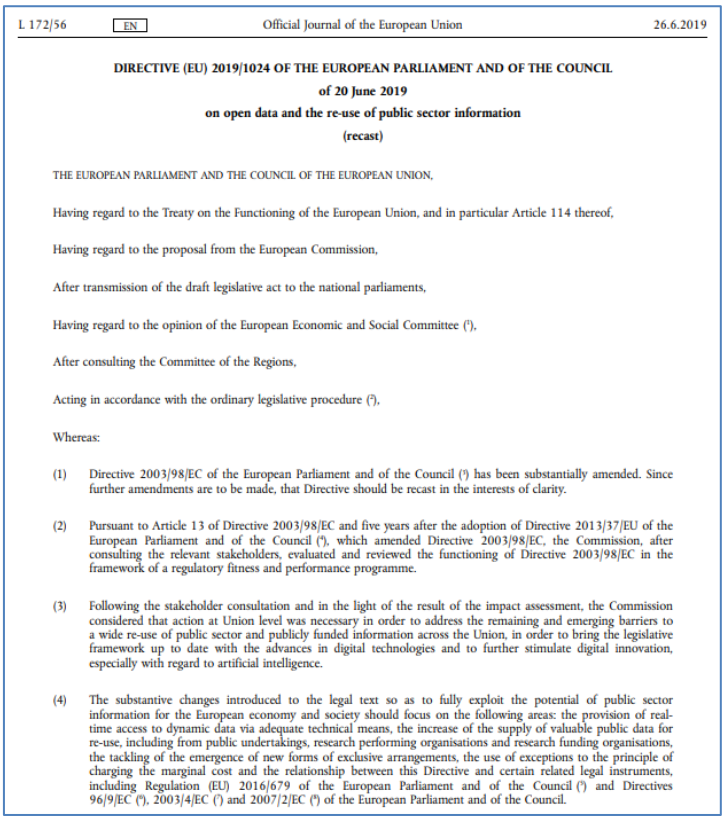
 # The open data directive

The **European Open Data Directive** aims to regulate data access, sharing, and usage within the EU to promote innovation, fairness, and transparency.

This directive recommend to apply the **FAIR principle**, ensuring that data is **findable, accessible, interoperable, and reusable**.

Interoperability is considered as a key point as it facilitates seamless data exchange across systems, while metadata enhances discoverability and usability.

Public access to data is a also key aspect, promoting openness and allowing citizens, researchers, and businesses to benefit from shared information while maintaining security and privacy safeguards.



L 172/56 EN Official Journal of the European Union 26.6.2019

DIRECTIVE (EU) 2019/1024 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 20 June 2019
on open data and the re-use of public sector information
(recast)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 114 thereof,

Having regard to the proposal from the European Commission,

After transmission of the draft legislative act to the national parliaments,

Having regard to the opinion of the European Economic and Social Committee (1),

After consulting the Committee of the Regions,

Acting in accordance with the ordinary legislative procedure (2),

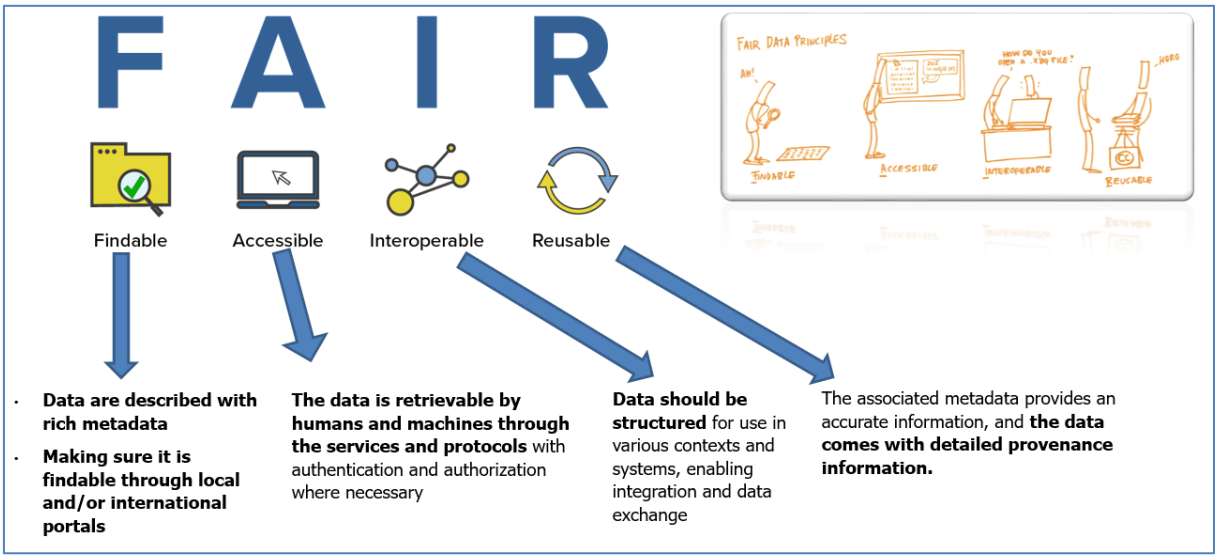
Whereas:

(1) Directive 2003/98/EC of the European Parliament and of the Council (3) has been substantially amended. Since further amendments are to be made, that Directive should be recast in the interests of clarity.

(2) Pursuant to Article 13 of Directive 2003/98/EC and five years after the adoption of Directive 2013/37/EU of the European Parliament and of the Council (4), which amended Directive 2003/98/EC, the Commission, after consulting the relevant stakeholders, evaluated and reviewed the functioning of Directive 2003/98/EC in the framework of a regulatory fitness and performance programme.

(3) Following the stakeholder consultation and in the light of the result of the impact assessment, the Commission considered that action at Union level was necessary in order to address the remaining and emerging barriers to a wide re-use of public sector and publicly funded information across the Union, in order to bring the legislative framework up to date with the advances in digital technologies and to further stimulate digital innovation, especially with regard to artificial intelligence.

(4) The substantive changes introduced to the legal text so as to fully exploit the potential of public sector information for the European economy and society should focus on the following areas: the provision of real-time access to dynamic data via adequate technical means, the increase of the supply of valuable public data for re-use, including from public undertakings, research performing organisations and research funding organisations, the tackling of the emergence of new forms of exclusive arrangements, the use of exceptions to the principle of charging the marginal cost and the relationship between this Directive and certain related legal instruments, including Regulation (EU) 2016/679 of the European Parliament and of the Council (5) and Directives 96/9/EC (6), 2003/4/EC (7) and 2007/2/EC (8) of the European Parliament and of the Council.



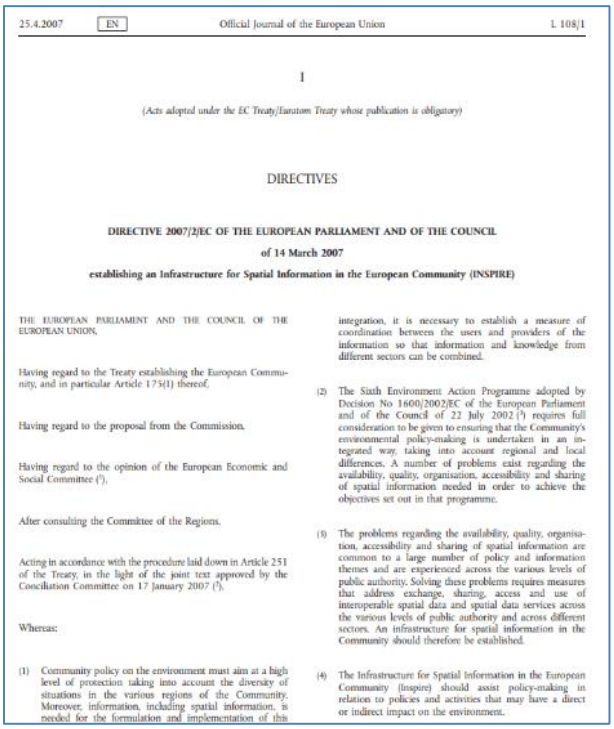
 # The inspire directive

The **INSPIRE Directive** aims to create a unified European spatial data infrastructure to support environmental policies and decision-making.

It **focuses on geographical data**, ensuring that spatial information from different countries is interoperable and easily shared.

Metadata plays a crucial role in describing and standardizing datasets, making them discoverable and usable across borders.

The directive also emphasizes **public access**, enabling citizens, researchers, and organizations to freely access and use geographical information while ensuring transparency and informed decision-making.



25.4.2007 EN Official Journal of the European Union L 108/1

I

(Acts adopted under the EC Treaty/Euratom Treaty whose publication is obligatory)

DIRECTIVES

DIRECTIVE 2007/2/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 14 March 2007
establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 175(1) thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Economic and Social Committee (1),

After consulting the Committee of the Regions,

Acting in accordance with the procedure laid down in Article 251 of the Treaty, in the light of the joint text approved by the Conciliation Committee on 17 January 2007 (2),

Whereas:

(1) Community policy on the environment must aim at a high level of protection taking into account the diversity of situations in the various regions of the Community. Moreover, information, including spatial information, is needed for the formulation and implementation of this integration, it is necessary to establish a measure of coordination between the users and providers of the information so that information and knowledge from different sectors can be combined.

(2) The Sixth Environment Action Programme adopted by Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 (3) requires full consideration to be given to ensuring that the Community's environmental policy-making is undertaken in an integrated way, taking into account regional and local differences. A number of problems exist regarding the availability, quality, organisation, accessibility and sharing of spatial information needed in order to achieve the objectives set out in that programme.

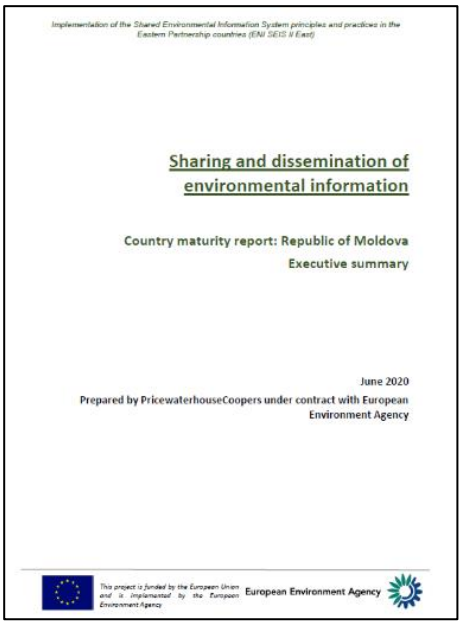
(3) The problems regarding the availability, quality, organisation, accessibility and sharing of spatial information are common to a large number of policy and information themes and are experienced across the various levels of public authority. Solving these problems requires measures that address exchange, sharing, access and use of interoperable spatial data and spatial data services across the various levels of public authority and across different sectors. An infrastructure for spatial information in the Community should therefore be established.

(4) The Infrastructure for Spatial Information in the European Community (Inspire) should assist policy-making in relation to policies and activities that may have a direct or indirect impact on the environment.

2.1.2. ENI SEIS Roadmap/ Sharing and dissemination of Env. Information

In the context of the ENI SEIS II East project 2016-2020, a report was produced in each EaP country for developing a roadmap and identify feasible and practical means for integrating environmental information in national e-governance/open data processes and platforms.

These reports were built in 2018 / 2019 and reviewed by public authorities, were based on the 2018 /2019 European Union reports on open data maturity in Europe with some adjustments to accommodate the specific situation of Eastern Partnership countries as well as the focus on environmental information.



Implementation of the Shared Environmental Information System principles and practices in the Eastern Partnership countries (ENI SEIS II East)

Sharing and dissemination of environmental information

Country maturity report: Republic of Moldova
Executive summary

June 2020
Prepared by PricewaterhouseCoopers under contract with European Environment Agency

This project is funded by the European Union and is implemented by the European Environment Agency

European Environment Agency

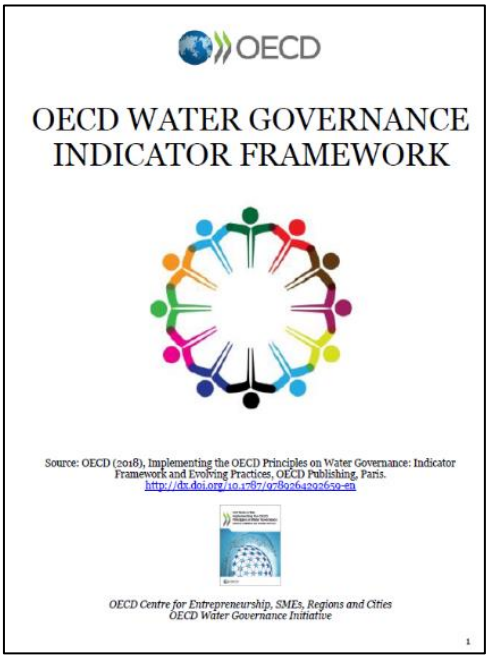
For each country, it presents an overview of the national e-government framework, the maturity level of open data and dissemination of environmental information and proposes a roadmap that includes measures focusing on the development of e-government and open data frameworks, which would greatly support the environmental domain and even beyond.

The measures recommended of the roadmap are grouped into the following categories: policy-related, legal and technical measures. They cover, in particular, the following issues:

- **Policy measures**: focusing, among others, to the **update of an e-government strategy**, enhancement of open data awareness in public authorities and supporting practical arrangements for open data collection, updating, quality control and dissemination.

- **Legal measures**: **setting out, among others the responsibilities of the subordinate institutions** in managing integrated environmental information systems and adopting international **standards for interoperability** and **metadata description**;

- **Technical measures: developing, among others,** a **single web access point for environmental information**, updating licensing terms and conditions, preparation of **metadata** description and enhancing the multilingual aspect of web portals and websites in the area of the environment.



Note: similar recommendations developed by OECD

It has to be noted that similar recommendations were developed by the OECD in the indicators of the "Principle 5 related to data and information" of the OECD Water governance Indicator framework.

2.2. Methodology of action in the frame of the output 2.4

In each country, an initial diagnosis phase allowed to launch the following activity:

- Review of the main legal/ institutional framework related to environmental data management
- Mapping of mains organization (producing /managing/ using data)
- Identification of the main environmental datasets and analysis of how these datasets are produced and stored by the various data producers (metadata)
- Questionnaire about open data maturity report applied to environment

Then, depending on the request of each country, various level of actions were defined. It included actions such as:

- Raising deciders awareness, supporting development of the legal /policy framework
- Completing dataset characterization (metadata in line with open data / Inspire)
- Developing national platforms demonstrating possible crossing/ visualization (portal, metadata catalogue, geographical database, tools visualization …)
- Working with voluntary partners supporting their information system with development of API facilitating the access to some important existing datasets
- Citizen participation / Hackathons

The main elements of methodology implemented and the results of these actions are presented for each county in the chapter 3.

All these actions applied the FAIR (Findable, Accessible, Interoperable, and Reusable) data principles to ensure long-term usability and integration of water-related data.

2.2.1. Analysis of the Institutional framework

In each country, an inventory of the main institutions/organizations producing / managing and/or using data related to the environment was realized.

The results are presented in form of:

- A list of institutions/organizations available on line
- A scheme mapping where the main institutions/organizations are located using their acronym (such as presented in the list)

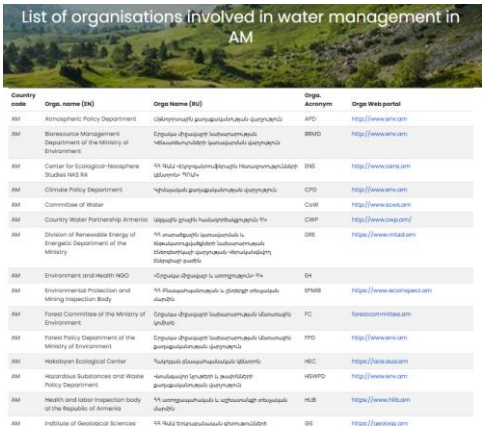


Figure 2: Example of on line list of institutions/organizations

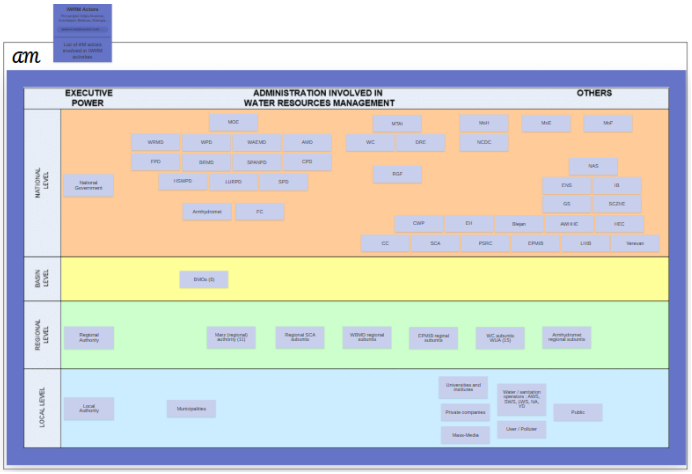


Figure 3: Diagram of the mapping of the main institutions/organizations in Armenia

2.2.2. Stimulating the production of metadata

In line with the open data directive and with the Inspire directive, the production of metadata were promoted as far as possible with participation of the organization concerned. For each environmental dataset, this metadata is particularly important to ensure its traceability. The identified datasets analyzed are classified in the form of static maps, web services, interactive maps, datasets and online applications. For the main datasets identified, PDF sheets have been developed describing the characteristics of the datasets.

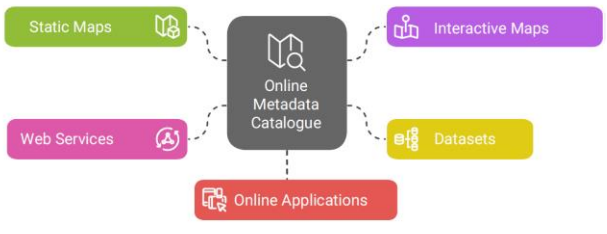


Figure 4: Diagram of the different types of data described in the metadata

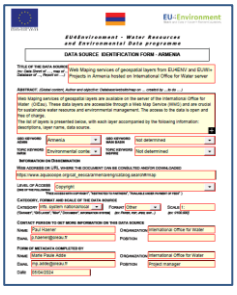


Figure 5: Example of a metadata sheet

The metadata contained in these records were then imported into a metadata catalog available online, which allows online identification and consultation of this metadata. Each country has its own metadata catalogue. In addition, applications have been developed so that this metadata can be visible on web portals in the form of an easily searchable list of data sources.

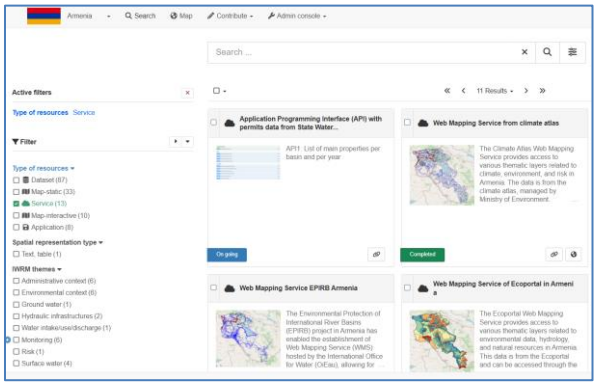


Figure 6: Example of consulting a metadata catalog

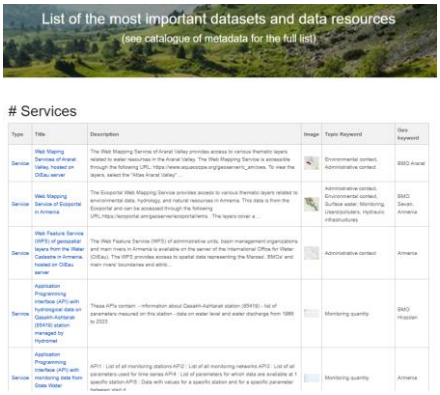


Figure 7: Example of online data source lists on a web portal, list connected to the metadata catalog

2.2.1. Developing data management platform prototypes

In order to demonstrate the possibility of integrating data from different sources and to exploit and visualize the available data, demonstration platforms have been set up for each country. These platforms include:

- A web portal for access to general information;
- A metadata catalog allowing the online visualization of metadata;
- An FTP folder for storing raw data.
- A geographical database, making it possible to record all types of information on the environment, whether it be the reference systems on river basins, the reference systems on the monitoring of surface water and groundwater, data on quality and quantity aspects, data on users and polluters, data on infrastructure, data on withdrawals and discharges, and indicators of any kind, which can refer to units administrative or environmental units;
- A web service server for the dissemination of WMS/WFS cartographic web services useful for the production of dynamic maps;
- An interactive dashboard visualization tool allowing the simultaneous display of dynamic maps and corresponding data visualization graphs

These platforms were developed as a demonstrator on a server of the OiEau, were presented to the partner country and are available for transfer in whole or in part according to needs and requests of the beneficiaries. The main issue for this transfer remain the lack of national organization mandated to coordinate and maintain such portal.

OiEau data management platform

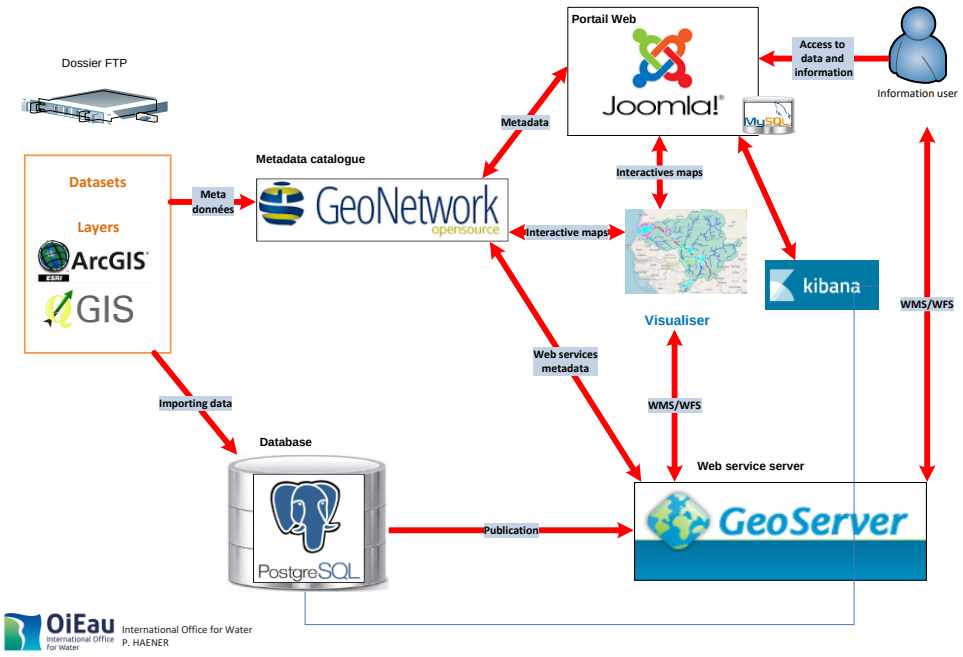


Figure 8: Structure of the data platform set up on the OiEau servers

2.2.2. Drafting web portal entry points

As recommended in the framework of the ENI/SEIS project roadmap, national portal prototypes were developed in order to demonstrate the possibilities of developing a web portal as an entry point to environmental data.

These portals allows to organize menus/sub-menus for presenting data by theme or region and provide access to data visualization products such as dynamic maps and interactive dashboards.

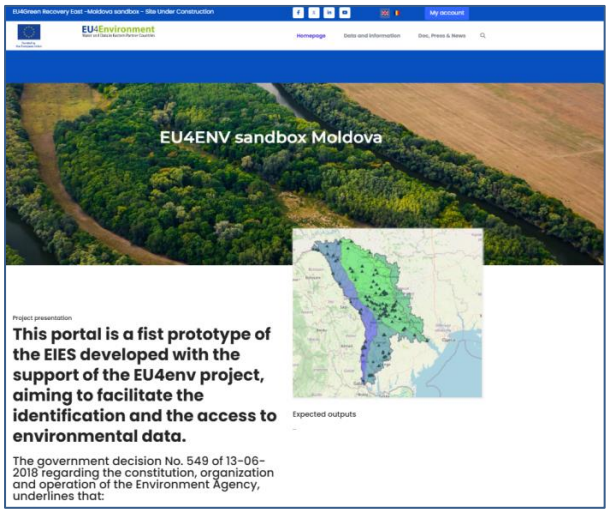


Figure 9: Example of a web portal for access to data

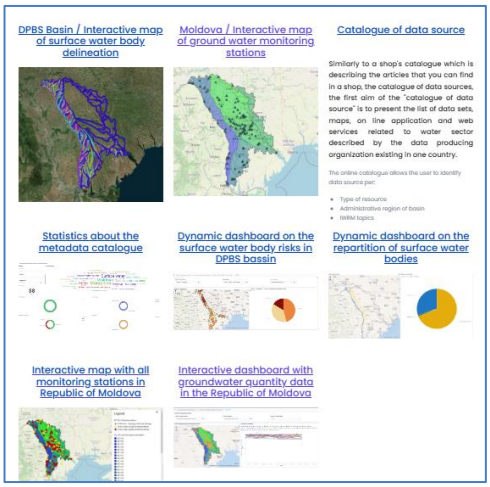


Figure 10: Example of a page showcasing data visualization products

2.2.3. Enhancing environmental data access through integration of API when reinforcing national water information systems

As the main objective of activity 2.4 is to reinforce teh access to environmental data, the logic was to strengthen the information systems of some data producers by helping them to integrate APIs that allow other authorized actors to easily access the data made available.

These actions were carried out with various producers who submitted request for such support. The project has therefore agreed to strengthen their information system on the condition that APIs are integrated that allow access to all or part of the data. These APIs can then be called by different actors in order to be able to consume and reuse the data

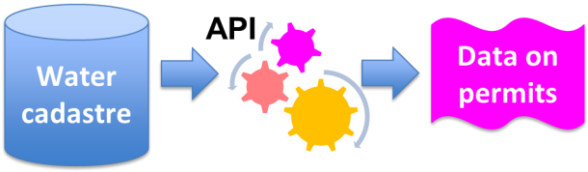


Figure 11: Case of Armenia where APIs allow to reinforce access to the water cadaste data

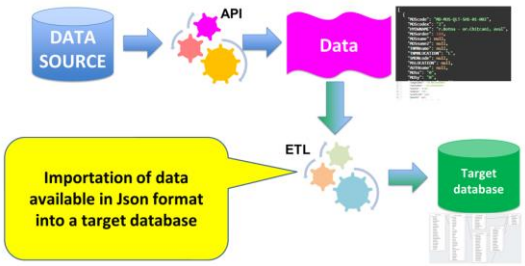


Figure 12: Diagram showing the methods of integrating data retrieved by API

2.2.4. Organizing workshops and hackathons to foster citizen participation.

In order to strengthen public participation and demonstrate the ease of access to data, hackathons were organized with students and young professionals.

These hackathons aimed to stimulate the reuse of public environmental data made available by public authorities at national and local level in order to develop new environmental products and services useful for decision makers and for public information/participation.

Candidate had to propose new products and services on the basis of the available data (and not to propose purchase of equipment saying if we can buy this we will do that ...)

The API developed by the project were particularly used for developing these new products and services.

Photo 1: Photos taken during the hackathons

Figure 13: Example of an application developed by a team of students during the 2 days of the hackathon using APIs

2.2.1. About open data maturity assessment 2022/24

In line with the maturity reports developed in European countries, the questionnaires for these maturity reports have been reused and adapted to environmental data on an informal basis.

Responses to questionnaires produced by various experts were collected and formatted in order to gain insight into expert views on access to environmental data in Eastern European countries.

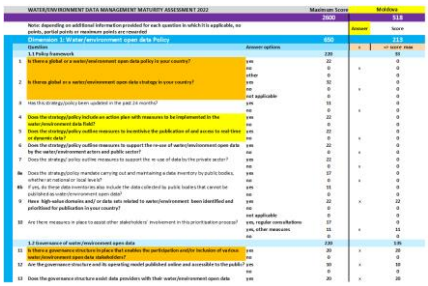


Figure 14: Maturity questionnaire adapted to environmental data

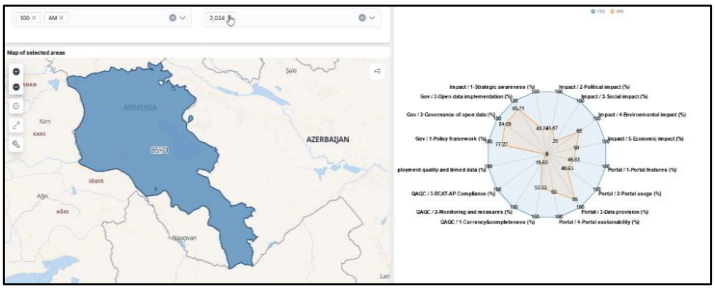


Figure 15: Example of visualization of the questionnaire result

3. Main results and achievements by country

3.1. Armenia

3.1.1. Analysis of the Institutional framework

The mapping of the main institutions/organizations producing/managing and/or using data related to the environment in Armenia is presented below.

A list of these institutions is available online at: https:// www.oieau-wiss2.org/AM/en/data-and-information/list-of-organisations.html

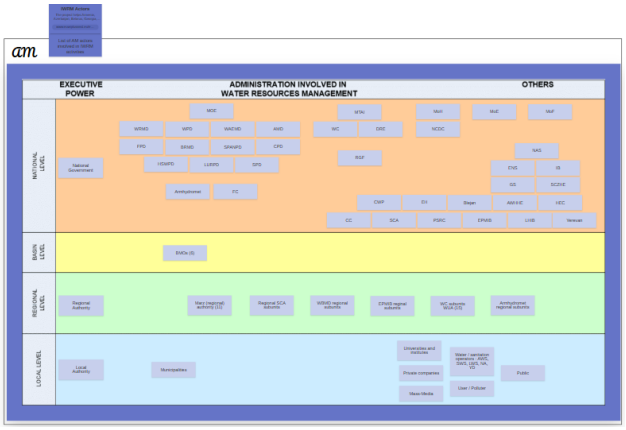


Figure 16: Mapping of the main institutions/organizations in Armenia

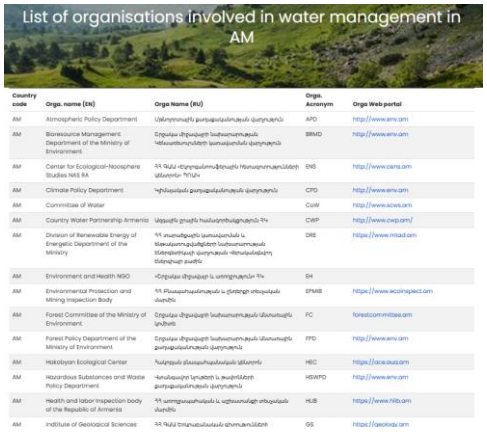


Figure 17: List of the main institutions /organizations in Armenia

3.1.1. Stimulating the production of metadata

A contract has been signed with a local expert to support the production of metadata in Armenia. The metadata produced was then verified, translated into English/Armenian, and then imported in order to be available in the online catalog available on the OiEau server at the following address: https://www.aquacoope.org/cat_eecca/armenia/eng/catalog.search#/search

The diagram below shows the number of sources given by type available in the online catalog as well as a screenshot of the online metadata consultation page.

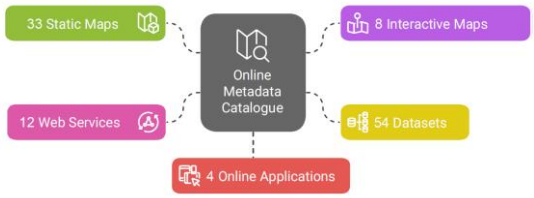


Figure 18: Number of data sources by type described in the Armenia metadata

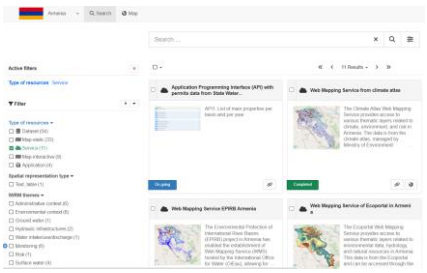


Figure 19: Screenshot of the online metadata page

3.1.2. Drafting web portal entry points

In Armenia, work has been done in collaboration with the GIZ project to formalize the environmental data entry point. Following discussions with the Ministry of the Environment, the Ecoportal available at https://ecoportal.am/en/page/home/ was selected as the official entry point. At this stage, this portal provides access to lists of actors and metadata. It remains to be developed on various other aspects.

In the meantime, all the water and environment data visualization products developed by the project are available on the OiEau demonstration portal, accessible at the following address: https://www.oieau-wiss2.org/AM/en/

The screenshots below show the home page of the Ecoportal and a page of the demonstration portal hosted at this stage on an OiEau server

Figure 20: Ecoportal home page

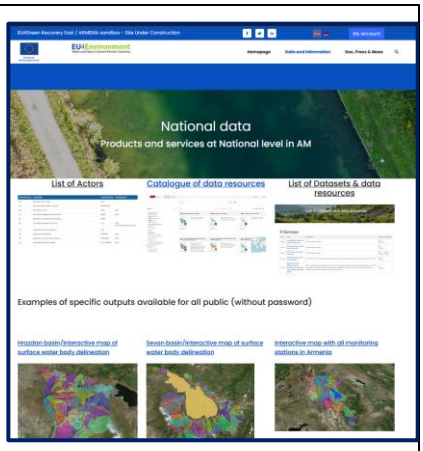


Figure 21: Copy of a page from the demo portal for Armenia available on the OiEau server

3.1.3. Enhancing environmental data access through integration of API reinforcing national water cadastre information systems

On the request of the water cadastre department of the Ministry of the environment, a tender was launched in order to improve the water cadastre database with development of the first API giving access to the data on permits.

On the basis of an updated database structure proposed the OiEau experts, the contract aims to develop online set of data management functionalities such as for data capture, data integration, data processing allowing to answer to the main needs expressed by the Water Resources Management Department, the public and integrated with other entities.

Some API were also defined and developed on the basis of specifications developed by OiEau.

The realization of this contract was a long process requiring the following activities:

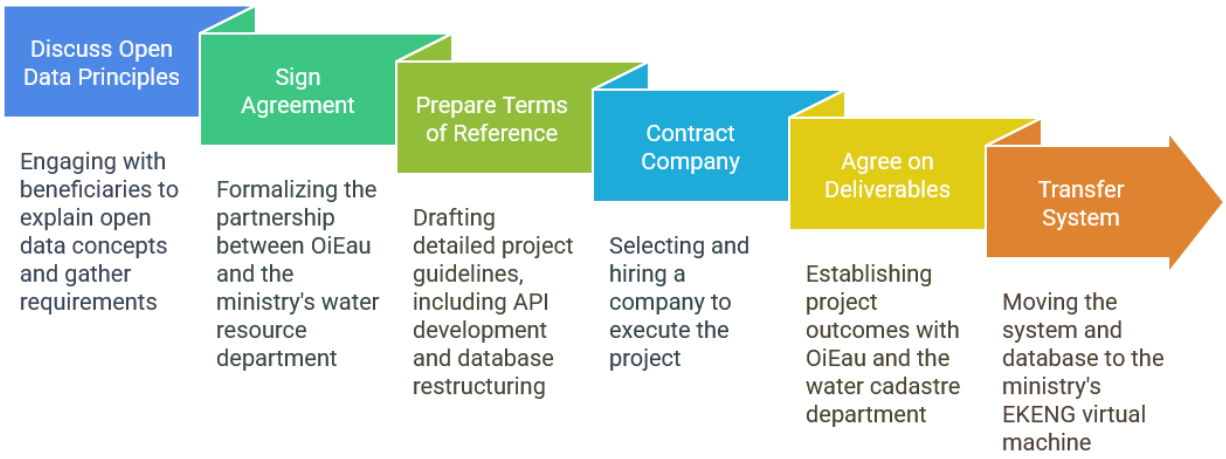


Figure 22 Main steps for the contract development

The reports of the consultant on this activity are available here

As planned, one of the main output was the availability of API allowing the consultation, download and reuse of the characteristics on the permits registered in the water cadastre, API available only from Armenia at the following address: http://83.139.3.140/am_swcis_api/index.html

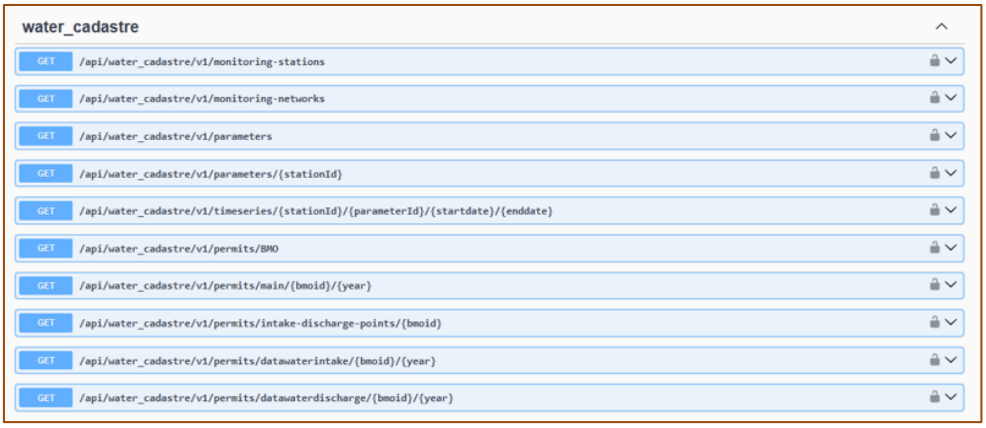


Figure 23: List of the main API allowing access to the data of the water cadastre

These API were particularly useful and demonstrate their efficiency during the Hackathon

3.1.4. Developing database and web services for data integration and processing

In order to demonstrate the possibility of data integration and visualization, a Postgres geodatabase was developed. As example, this database integrate the characteristics of various monitoring networks and stations and to integrate data coming from these monitoring networks.

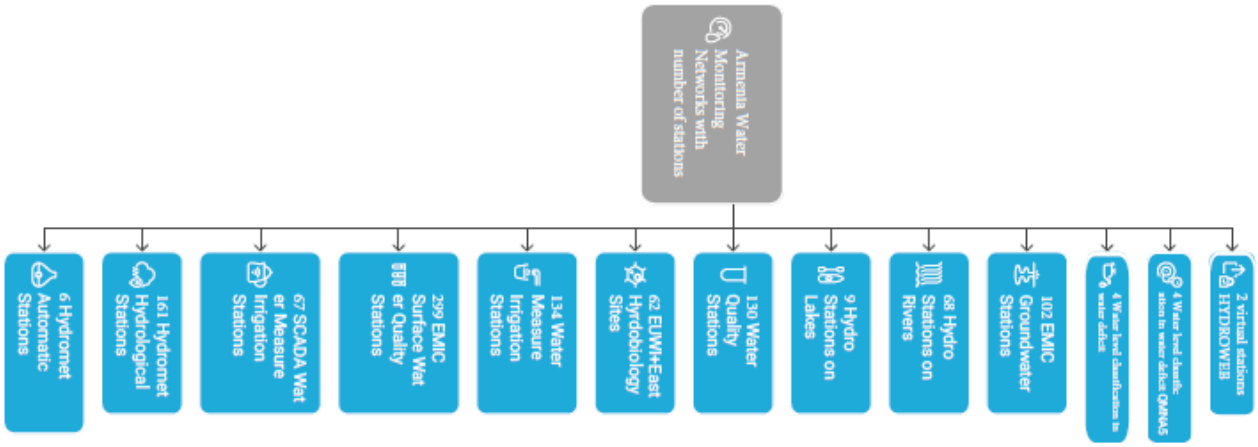


Figure 24: Diagram showing the number of monitoring stations for each network in the database

In addition, a set of geographical layers has been integrated into the Postgres database and made available through the geographical layer server "Geoserver", in the form of WMS and WFS web services.

More than 250 layers were published in WMS service allowing to create the interactive maps combining different WMS / WFS services locally or directly in the metadata catalogue

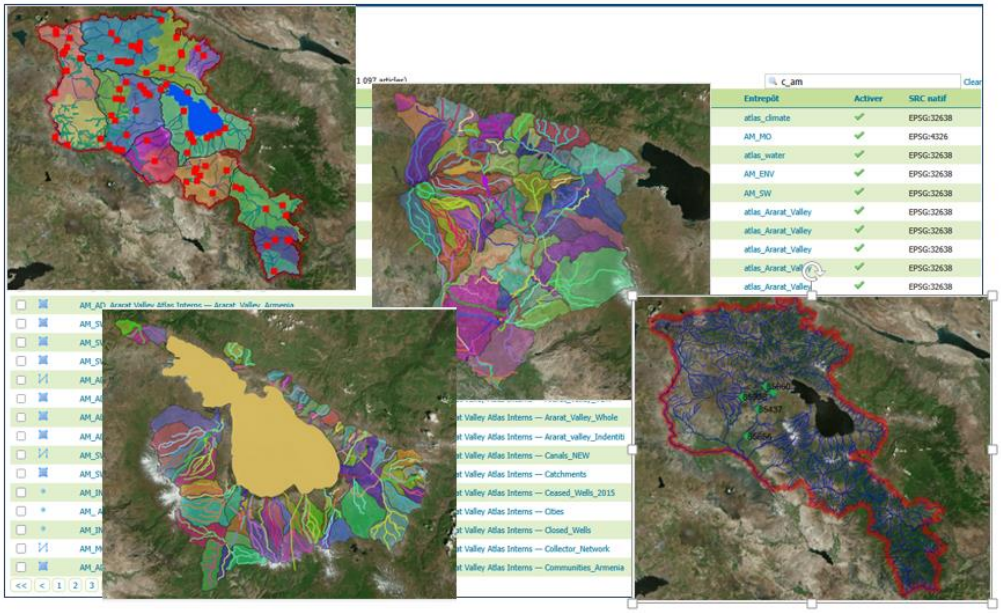


Figure 25: Examples of web services and dynamic maps produced using web services in Armenia

3.1.5. Developing data visualization products

In addition to dynamic maps, the web services and the database offer the possibility of developing interactive dashboards such as those presented below. These dashboards allow interaction between the map and the graphs, for example, by selecting objects on the map and automatically modifying data on the graphs and vice versa.

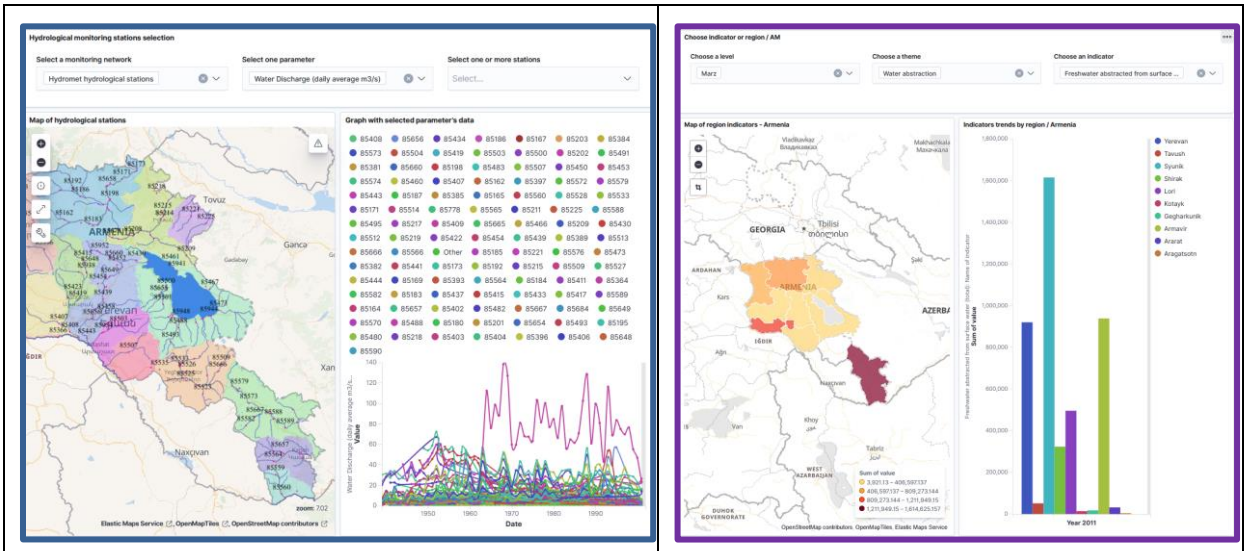


Figure 26: Example of dashboard in Armenia

3.1.6. Hackathon

Figure 27: Poster for the hackathon in Armenia

In order to promote access to environmental data and bring to life environmental datasets made available by national services, a 2-day hackathon was organized in Armenia at the invitation of the Ministry of the Environment, on the basis of a proposal presented by the project.

The aim was to invite teams of students and young professionals to leverage the inventory of datasets and web services developed as part of the project to produce new information services useful to decision-makers and the public.

Preparing for this hackathon involved several steps, as shown in this diagram:

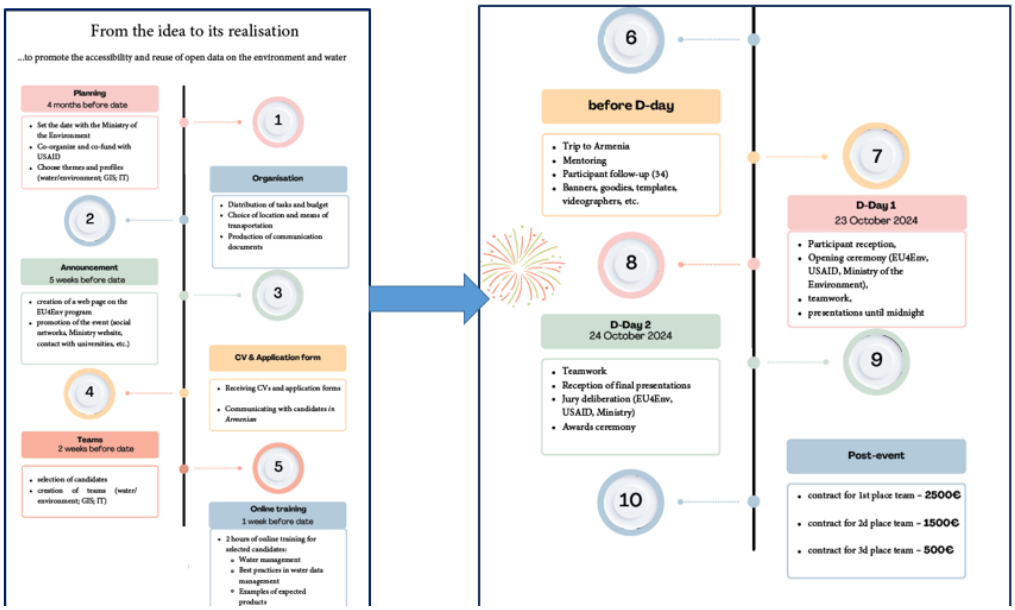


Figure 28: Main steps for the preparation of the hackathon

This hackathon brought together 40 students and young professionals, organized into teams of 5 to 7 people. On the second day, the teams presented their projects, and the steering committee selected the winners.

The winning teams presented the following projects:

- Team 1. Data Management Platform with permits data
- Team 2. Analysis of Industrial Pollution in the Southern Basin
- Team 3. Fluctuations in Lake Sevan Water Levels

Photos 1: Photos from the Hackathon in Armenia

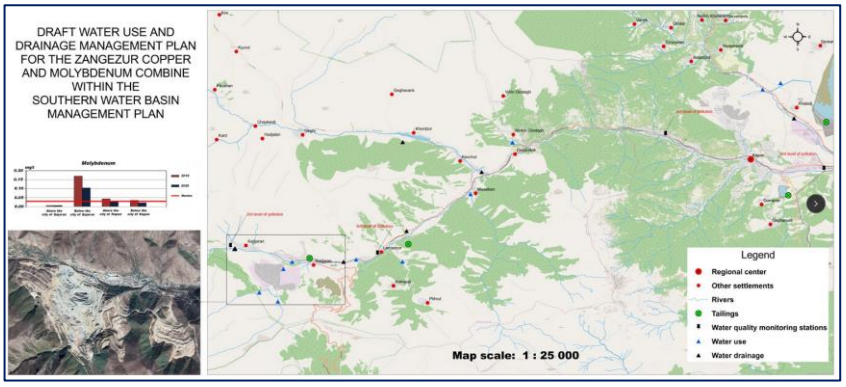


Figure 29: Example of resulting products of the hackathon (see Link to the deliverables)

3.1.7. About open data maturity assessment 2022/24

As indicated in Chapter 2, questionnaires used for the European Maturity Report, were adapted to environmental data and distributed to various experts in Armenia.

The following diagrams present a summary of the indicators from this questionnaire at the beginning and end of the project:

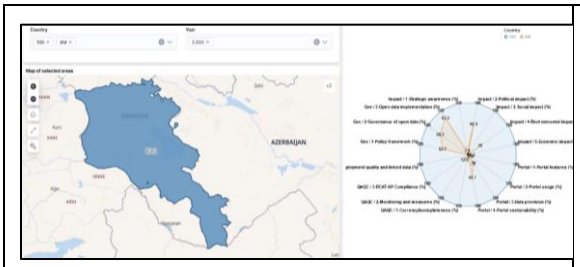


Figure 30: Indicators from the questionnaire at the start of the project

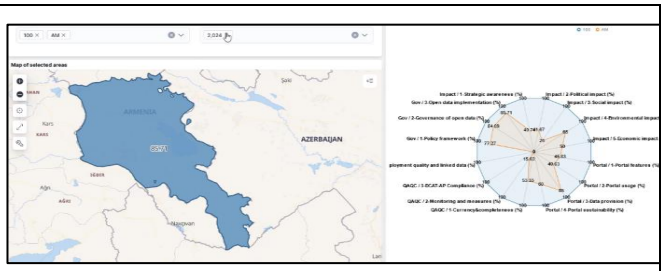


Figure 31: Indicators from the questionnaire at the end of the project

3.2. Azerbaijan

3.2.1. Analysis of the Institutional framework

The mapping of the main institutions/organizations producing/managing and/or using data related to the environment in Armenia is presented below.

A list of these institutions is available online at: https://www.oieau-wiss.org/ekoportal-az/en/data/list-of-stakeholders.html

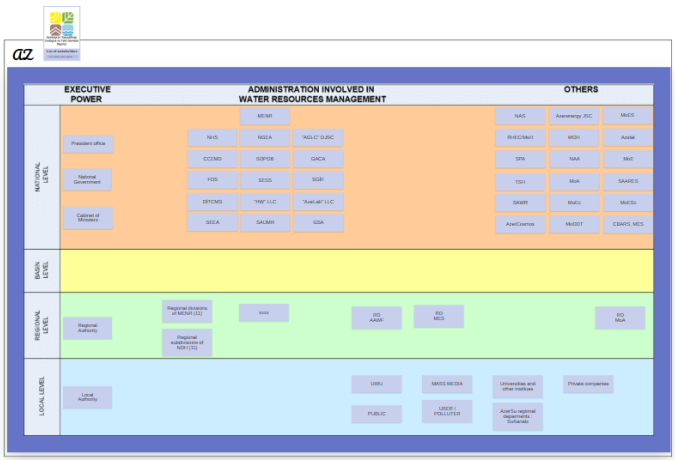


Figure 32: Mapping of the main institutions/organizations in Azerbaijan

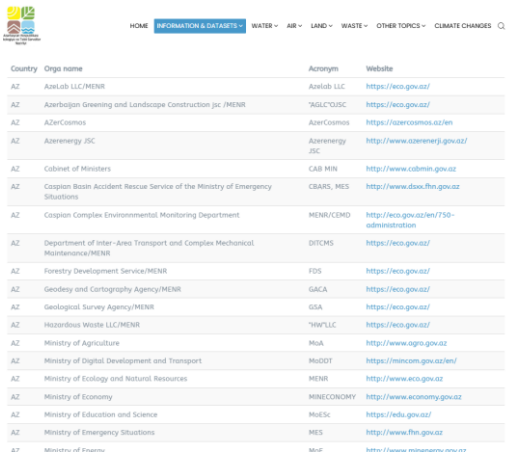


Figure 33 List of the main institutions /organizations in Azerbaijan

3.2.2. Stimulating the production of metadata

With the support of the project counterpart at the ministry level, some metadata were produced and imported in order to be available in the online catalog available on the OiEau server at the following address: https://www.aquacoope.org/cat_eecca/**azerbaijan**/eng/catalog.search#/search

The diagram below shows the number of sources given by type available in the online catalog as well as a screenshot of the online metadata consultation page.

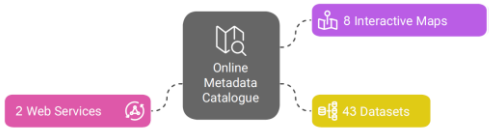


Figure 34: Number of data sources by type described in the Azerbaijan metadata

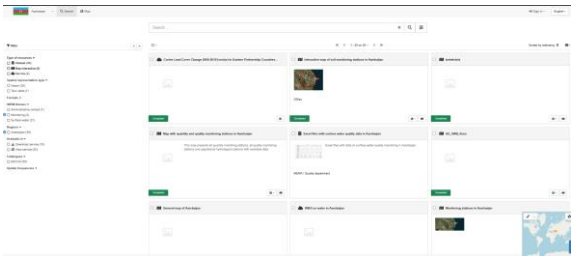


Figure 35: Screenshot of the online metadata page

3.2.1. Drafting web portal entry points

In Azerbaijan, work has been done to formalize the environmental data entry point. Following discussions with the Ministry of the Environment, the Ekoportal was selected as the official entry point. As this portal remains to be developed all the water and environment data visualization products developed by the project are available on the OiEau demonstration portal, accessible at the following address: https://www.oieau-wiss.org/ekoportal-az/en

The screenshots here joined shows the home page of the eco-portal and a page of the demonstration portal hosted at this stage on an OiEau server

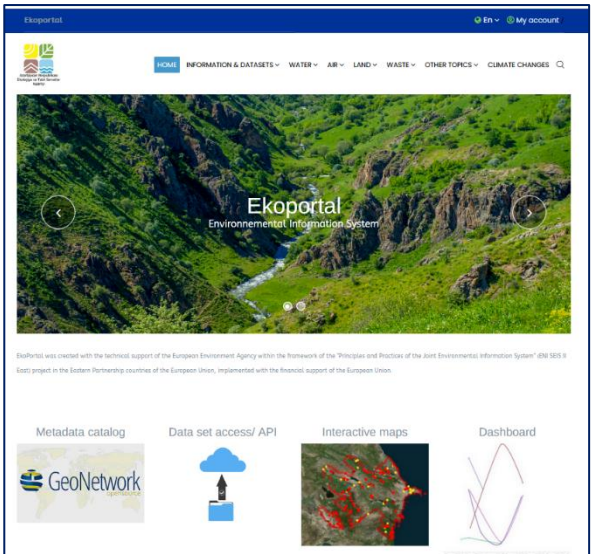


Figure 36: Copy of a page from the demo portal for Azerbaijan available on the OiEau server

3.2.2. Developing database and web services for data integration and processing

In order to demonstrate the possibility of data integration and visualization, a Postgres geodatabase was developed. As example, this database integrate the characteristics of various monitoring networks and stations and to integrate data coming from these monitoring networks

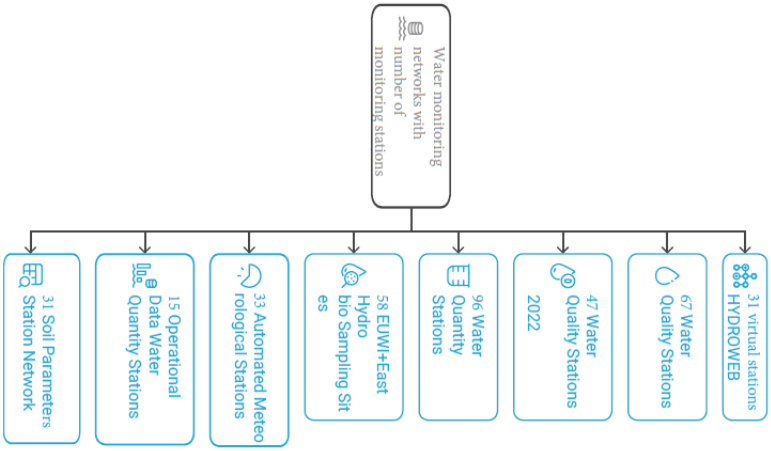


Figure 37: Diagram showing the number of monitoring stations for each network in the database

In addition, a set of geographical layers has been integrated into the Postgres database and made available through the geographical layer server "Geoserver", in the form of WMS and WFS web services.

More than 30 layers were published in WMS service allowing to create the interactive maps combining different WMS / WFS services locally or directly in the metadata catalogue

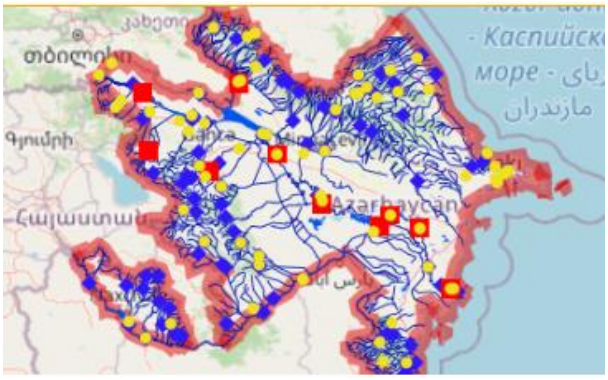


Figure 38: Examples of web services and dynamic maps produced using web services

3.2.3. Developing data visualization products

In addition to dynamic maps, the web services and the database offer the possibility of developing interactive dashboards such as those presented below. These dashboards allow interaction between the map and the graphs, for example, by selecting objects on the map and automatically modifying data on the graphs and vice versa.

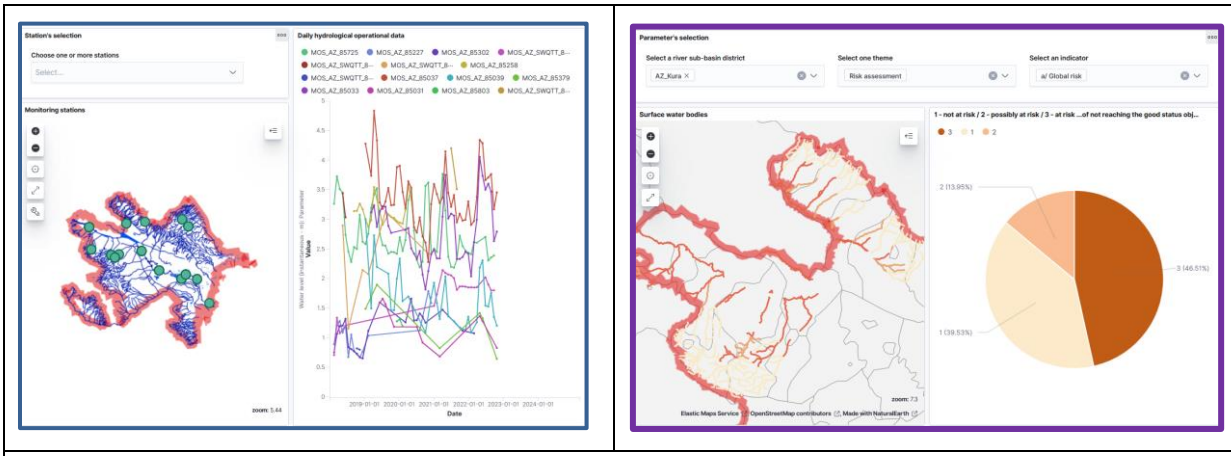


Figure 39: Example of dashboard in Azerbaijan

3.2.4. Demonstrating the possibility to develop a database on hydrological data

As hydrological data were still dispersed into various information systems without possibility to consult historical data, a database integrating some hydrological datasets was drafted and APIs allowing demonstrating potential data exchange procedure were developed and made available at the following address: https://www.oieau-wiss.org/az-hydro/api/swagger-ui/index.html#/

These API give access to data on hydrological monitoring networks, stations, parameters, data at monitoring stations.

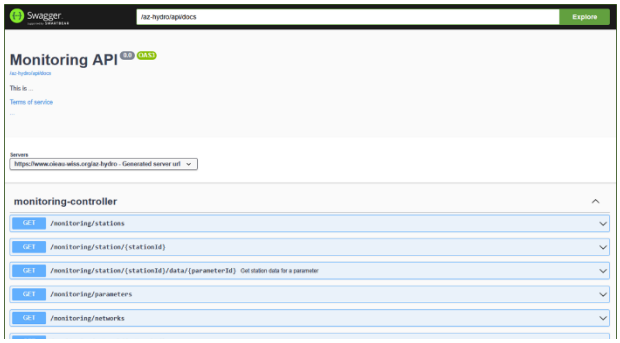


Figure 40: demo of API for Azerbaijan

3.3. Moldova

3.3.1. Analysis of the Institutional framework

The mapping of the main institutions/organizations producing/managing and/or using data related to the environment in Armenia is presented below.

A list of these institutions is available online at: https://www.oieau-wiss2.org/MD/en/data-and-information/list-of-organisations.html

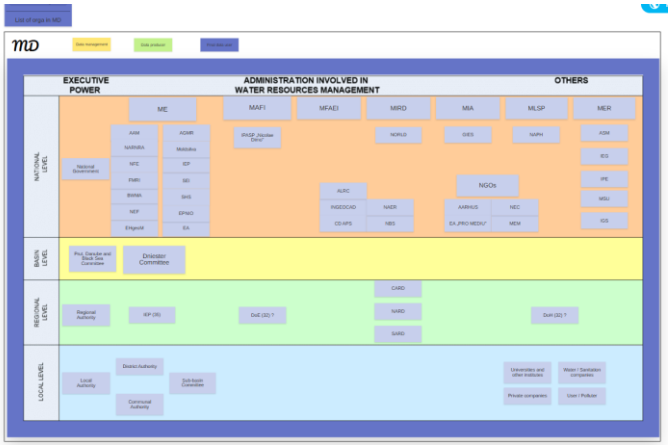


Figure 41 Mapping of the main institutions/organizations in Moldova

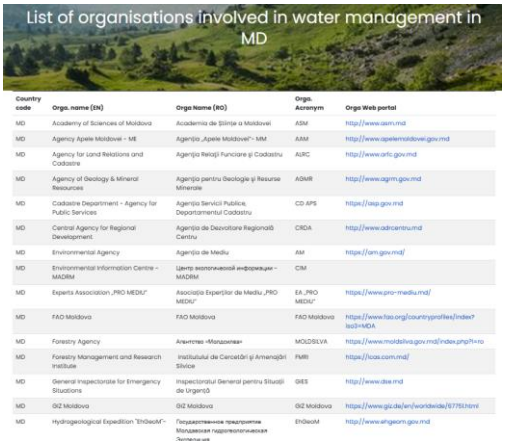


Figure 42: List of the main institutions /organizations in Moldova

3.3.2. Stimulating the production of metadata

A contract has been signed with a local expert to support the production of metadata in Moldova. The metadata sheets produced were then verified, translated into English/Romanian, and imported in order to be available in the online catalog available on the OiEau server at the following address: https://www.aquacoope.org/cat_eecca/moldova/eng/catalog.search#/search

The diagram below shows the number of sources given by type available in the online catalog as well as a screenshot of the online metadata consultation page.

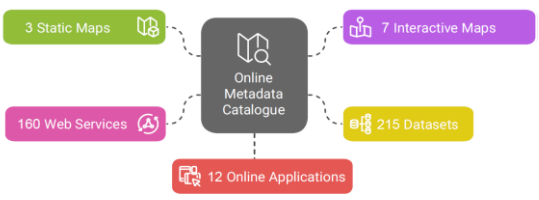


Figure 43: Number of data sources by type described in the Moldova, metadata

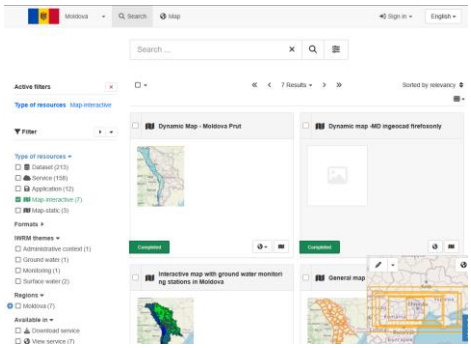


Figure 44: Screenshot of the online metadata page

3.3.3. Drafting web portal entry points

In Moldova, there is no existing unique environmental data entry point. However the concept of Integrated Environmental Information system, appears in various project proposal and conceptual document has still to be developed and validated

In order to illustrate how could be structured the entry point portal of this Integrated Information system, a demonstration portal was drafted and hosted at this stage on an OiEau server. The screenshots below show the home page and the page presenting some national products of information

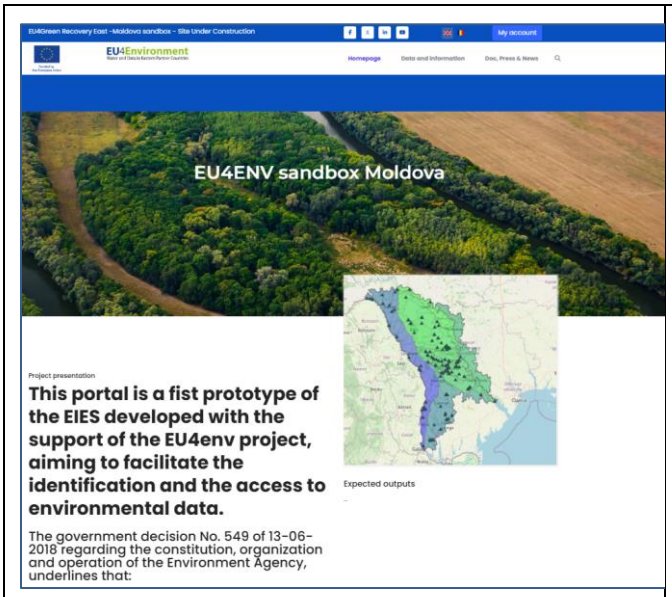


Figure 45: Copy of a page from the demo portal available on the OiEau server

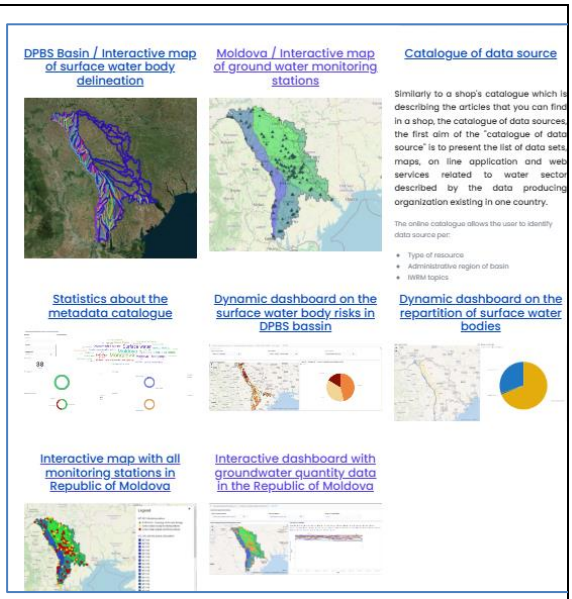


Figure 46: Page presenting some national products of information

3.3.4. Enhancing environmental data access through integration of API reinforcing national water cadastre information systems

On the request of the Environmental agency depending from the Ministry of the environment, a tender was launched in order to improve the surface water quality database and the solid waste database with development of the first API giving access to the corresponding datasets.

On the basis of an updated database structure proposed the OiEau experts, the contract aims to develop online set of data management functionalities such as for data capture, data integration, data processing allowing to answer to the main needs expressed by the Water Resources Management Department, the public and integrated with other entities.

Some API were also defined and developed on the basis of technical specifications developed by OiEau.

The realization of this contract was a long process requiring the following activities:

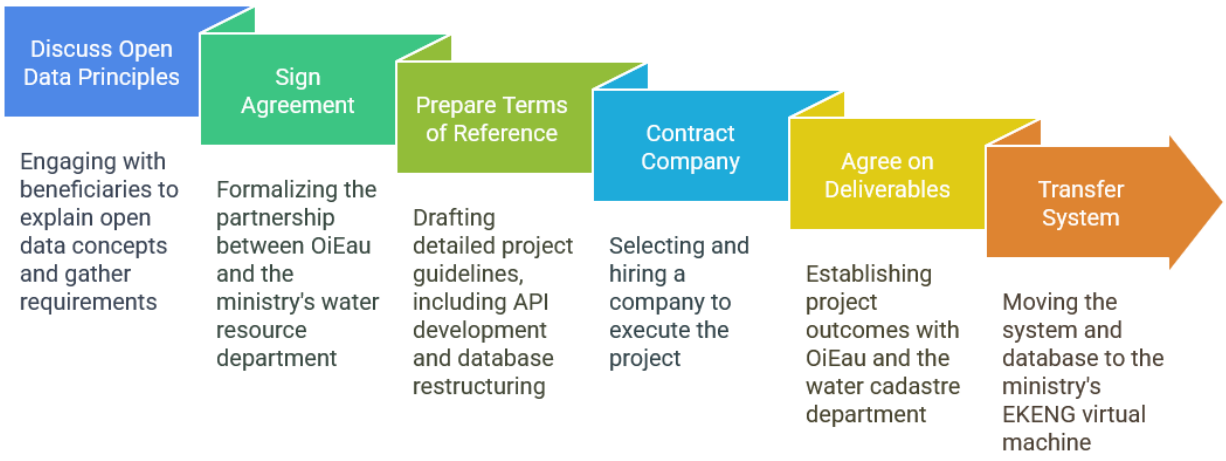


Figure 47: Main steps for the contract development

The reports of the consultant on this activity are available here: Link to the deliverables

As planned, one of the main output was the availability of API allowing the consultation, download and reuse of the surface water quality database and of the solid waste database, at the following address: http://83.139.3.140/am_swcis_api/index.html

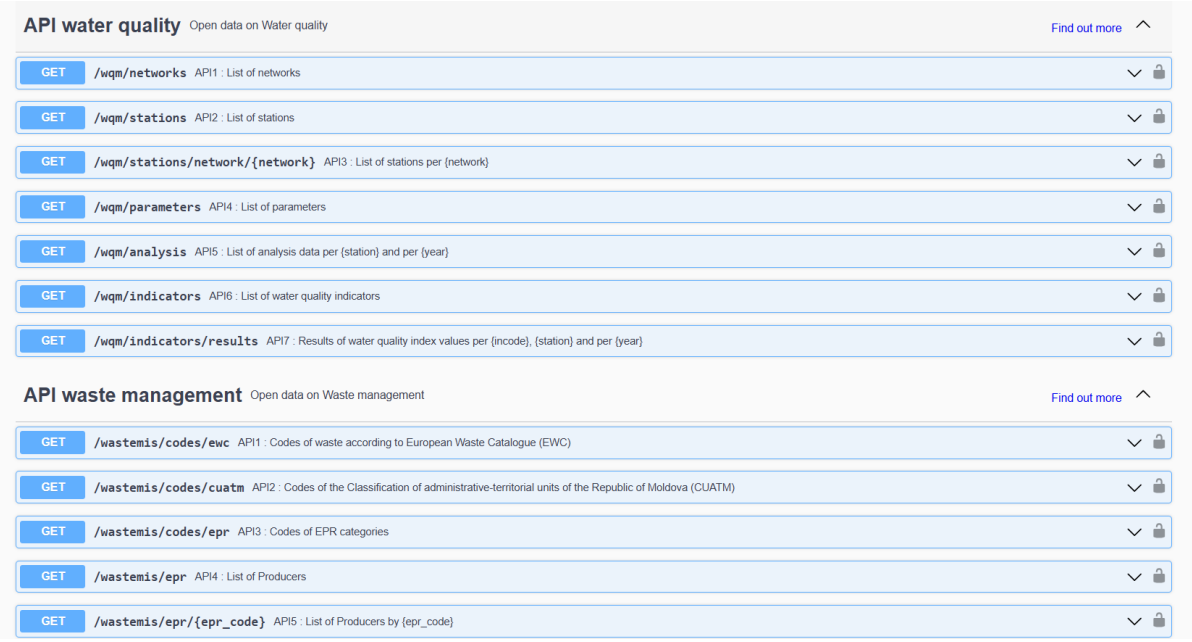


Figure 48: List of the main API allowing access to the data of the surface water quality database and of the solid waste database

These API available at https://siamd.gov.md/restapi/swagger

They were particularly useful and demonstrate their efficiency during the Hackathon.

3.3.5. Developing database and web services for data integration and processing

In order to demonstrate the possibility of data integration and visualization, a Postgres geodatabase was developed. As example, this database integrate the characteristics of various monitoring networks and stations and to integrate data coming from these monitoring networks

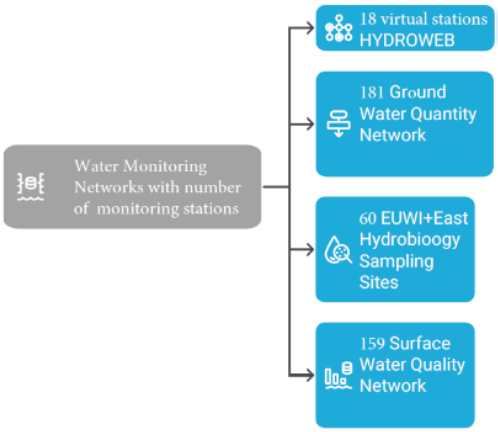


Figure 49: Diagram showing the number of monitoring stations for each network in the database

In addition, a set of geographical layers has been integrated into the Postgres database and made available through the geographical layer server "Geoserver" in the form of WMS and WFS web services.

More than 25 layers were published in WMS services allowing to create the interactive maps combining different WMS / WFS services locally or directly in the metadata catalogue.

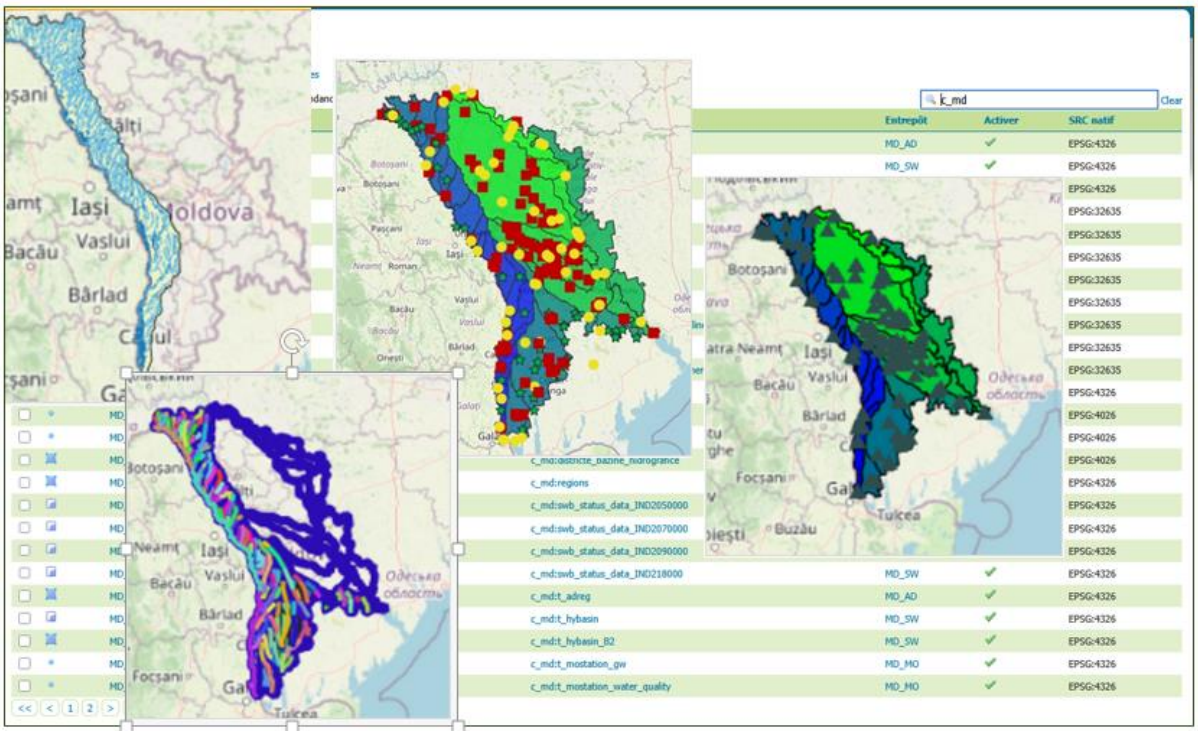


Figure 50: Examples of web services and dynamic maps produced using web services

3.3.6. Developing data visualization products

In addition to dynamic maps, the web services and the database offer the possibility of developing interactive dashboards such as those presented below. These dashboards allow interaction between the

map and the graphs, for example, by selecting objects on the map and automatically modifying data on the graphs and vice versa.

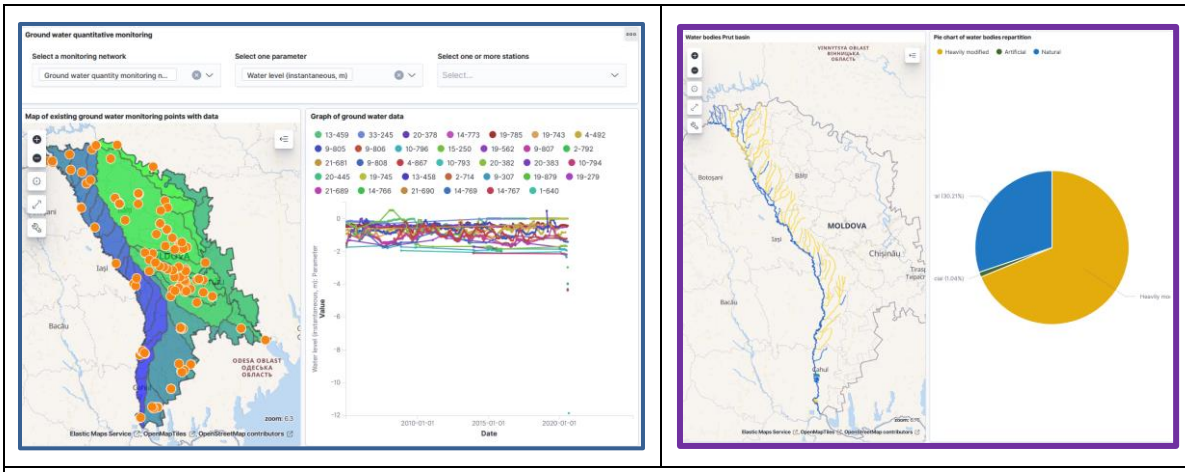


Figure 51: Example of dashboard in Moldova

3.3.7. Hackathon

Figure 52: Poster for the hackathon in Moldova

In order to promote access to environmental data and bring to life environmental datasets made available by national services, a 2-day hackathon was organized in Moldova at the invitation of the Ministry of the Environment, on the basis of a proposal presented by the project.

The aim was to invite teams of students and young professionals to leverage the inventory of datasets and web services developed as part of the project to produce new information services useful to decision-makers and the public.

Preparing for this hackathon involved several steps, as shown in this diagram:

This hackathon brought together 38 students and young professionals, organized into teams of 5 to 7 people. On the second day, the teams presented their projects, and the steering committee selected the winners.

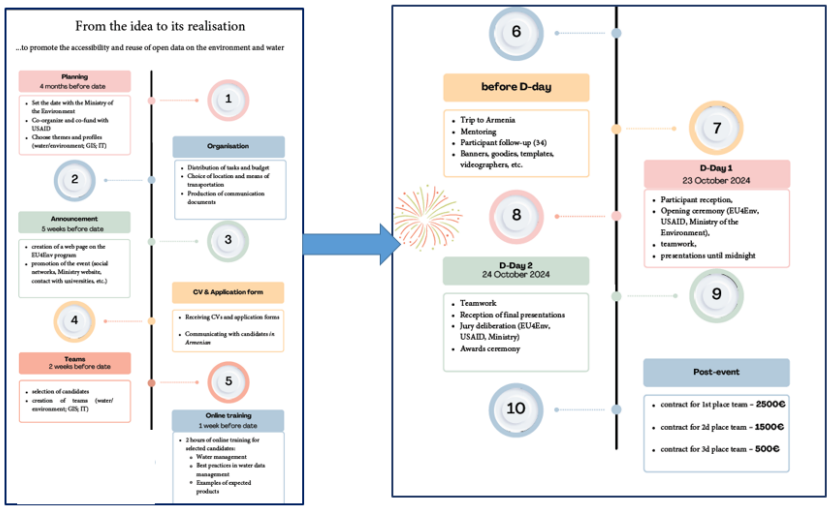


Figure 53: Main steps for the preparation of the hackathon

The winning team exploited fully the API developed by the project, developing and presenting an application allowing the mapping of surface water quality monitoring point, with visualization of the graph of values for each water quality parameter.

This application was latter implemented on an OiEau server and is accessible online at the following address: http://37.59.180.2

Photos 2: Photos of the Hackathon in Moldova

Figure 54: Example of resulting products (Link to the deliverables)

3.4. Georgia

3.4.1. Analysis of the Institutional framework

The mapping of the main institutions/organizations producing/managing and/or using data related to the environment in Armenia is presented below.

A list of these institutions is available online at: https://www.oieau-wiss2.org/GE/en/data-and-information/list-of-organisations.html

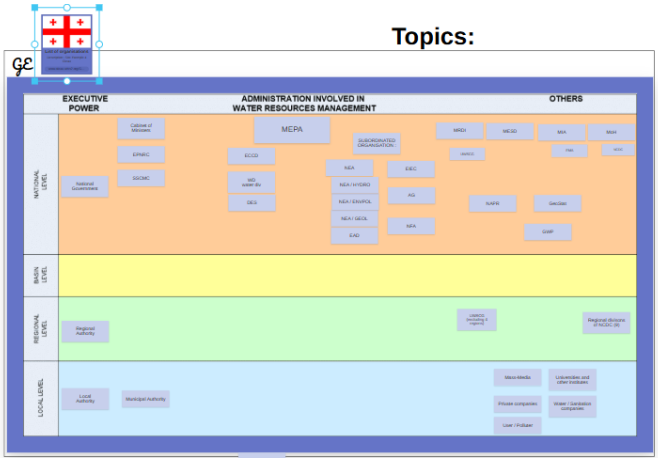


Figure 55 Mapping of the main institutions/organizations in Georgia

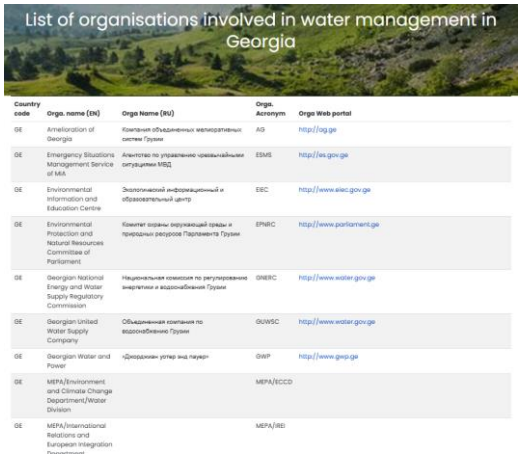


Figure 56: List of the main institutions /organizations in Georgia

3.4.2. Stimulating the production of metadata

A contract has been signed with a local expert to support the production of metadata in Georgia. The metadata produced was then verified, translated into English/Georgian, and then imported in order to be available in the online catalog available on the OiEau server at the following address: https://www.aquacoope.org/cat_eecca/**georgia**/eng/catalog.search#/search

The diagram below shows the number of sources given by type available in the online catalog as well as a screenshot of the online metadata consultation page.

Figure 57: Number of data sources by type described in the Georgian metadata

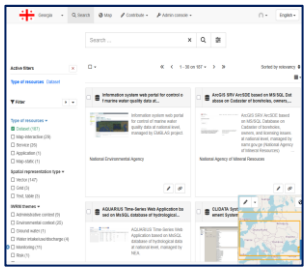


Figure 58: Screenshot of the online metadata page for Georgia

3.4.3. Drafting web portal entry points

In order to illustrate how could be structured an environmental data entry point in Georgia. a demonstration portal was drafted and hosted at this stage on an OiEau server. The screenshots below show the home page and of the page presenting some national products of information

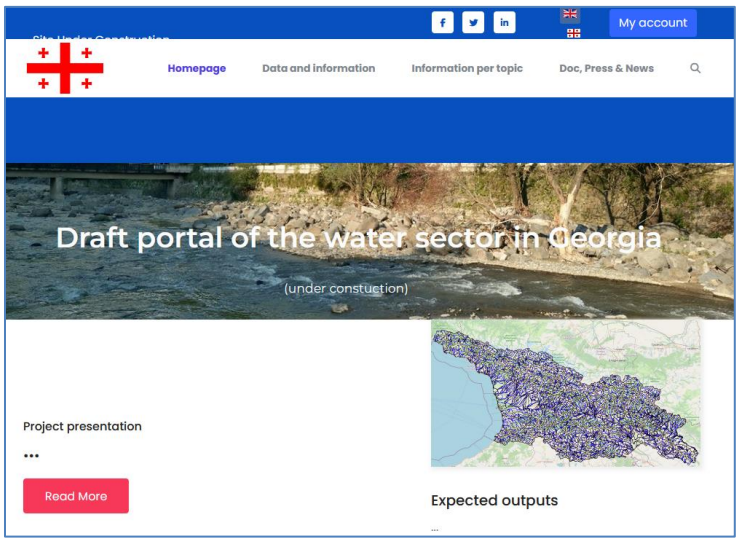


Figure 59: Copy of a page from the demo portal for Georgia available on the OiEau server

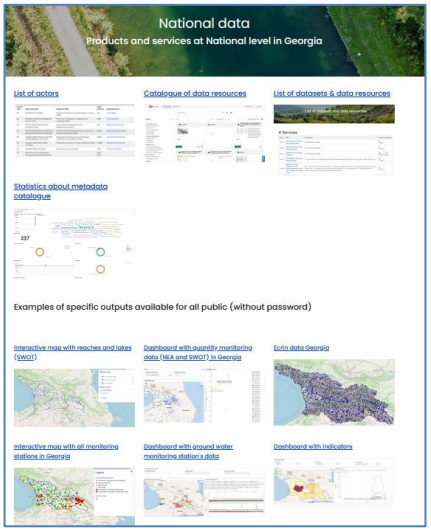


Figure 60: Page presenting some national products of information

3.4.4. Enhancing environmental data access through integration of API reinforcing national water cadastre information systems

On the request of the National environmental Agency, a tender was launched in order to improve the water use declaration database with development of the first API giving access to the corresponding datasets.

On the basis of an updated database structure proposed the OiEau experts, the contract aimed to develop API On the basis of specifications developed by OiEau and to develop new functionalities for reporting

The realization of this contract was a long process requiring the following activities:

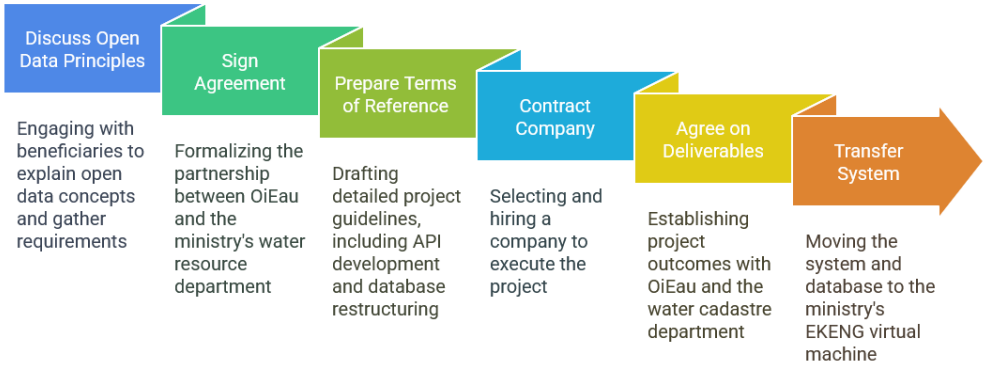


Figure 61: Main steps for the contract development

The reports of the consultant on this activity are available here: Link to the deliverables

As planned, one of the main output was the availability of API allowing the consultation, download and reuse of the list of water intake and discharge points with coordinates per basin, data on water intake point per year and per basin, data on water discharge point per year and per basin, at the following address: https://ms.emoe.gov.ge/api/swagger/ui/index#/

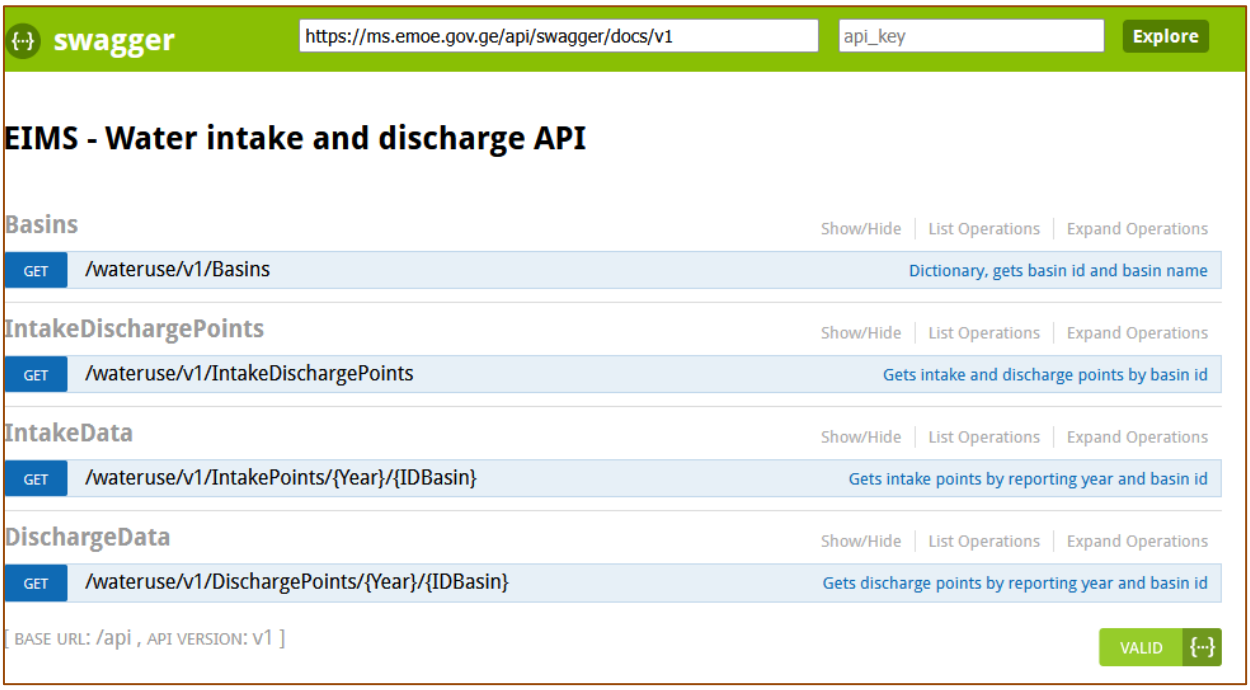


Figure 62: List of the main API allowing access to the water use declaration data

3.4.5. Developing database and web services for data integration and processing

In order to demonstrate the possibility of data integration and visualization, a Postgres geodatabase was developed. As example, this database integrate the characteristics of various monitoring networks and stations and to integrate data coming from these monitoring networks.

In addition, a set of geographical layers has been integrated into the Postgres database and made available through the geographical layer server "Geoserver", in the form of WMS and WFS web services.

More than 90 layers are published in WMS service allowing to create the interactive maps combining different WMS / WFS services locally or directly in the metadata catalogue

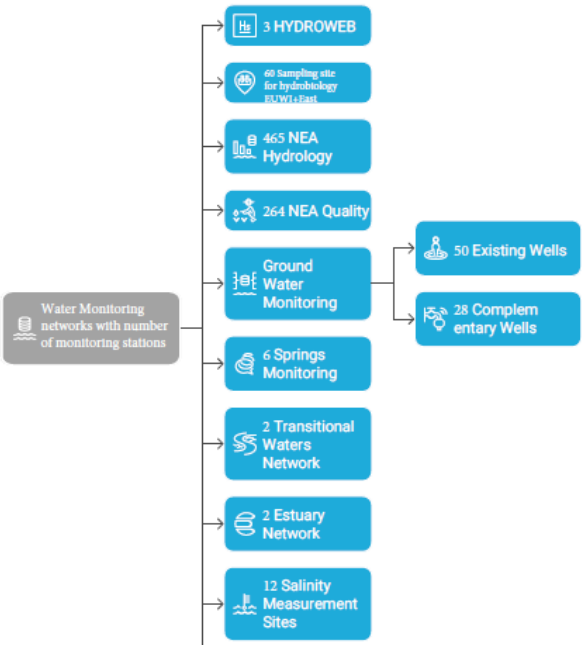


Figure 63 Diagram showing the number of monitoring stations for each network in the database

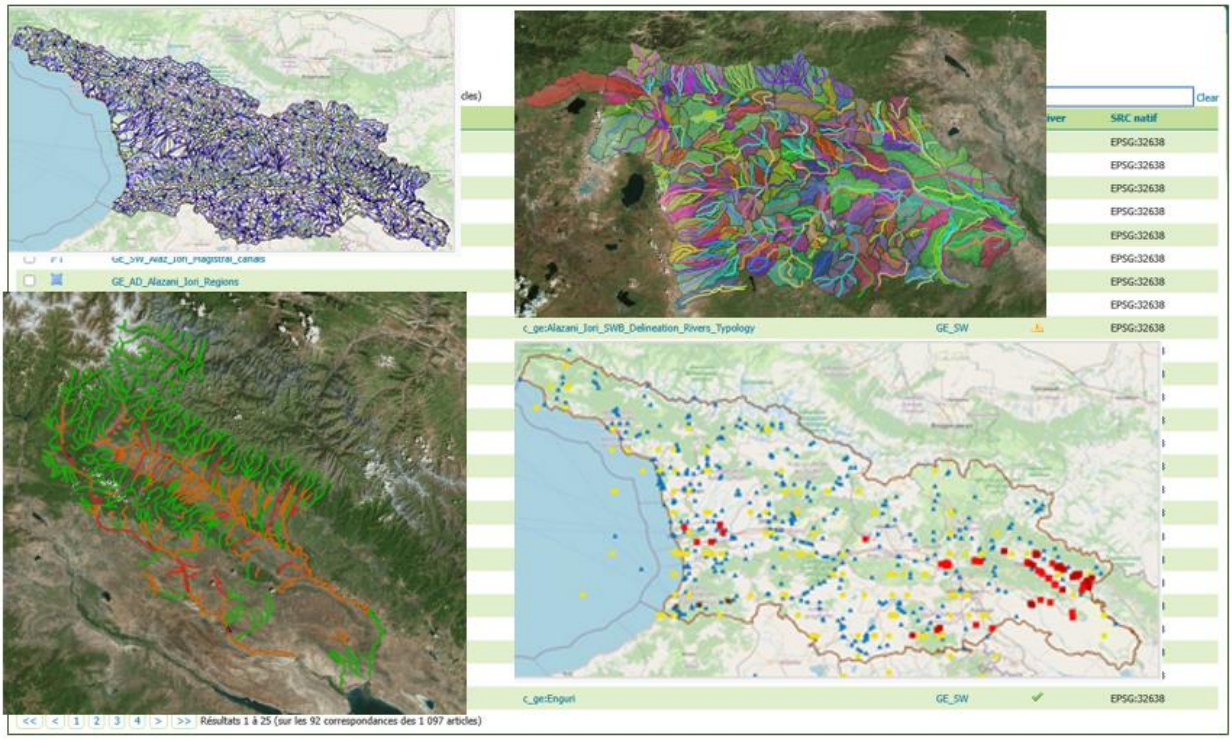
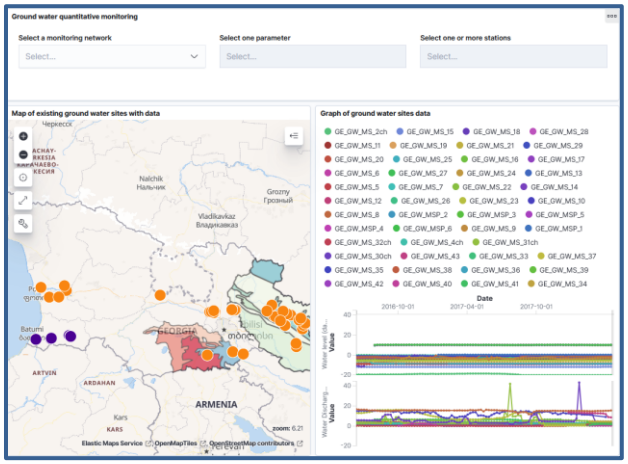


Figure 64: Examples of web services and dynamic maps produced using web services

3.4.6. Developing data visualization products

In addition to dynamic maps, the web services and the database offer the possibility of developing interactive dashboards such as those presented below. These dashboards allow interaction between the map and the graphs, for example, by selecting objects on the map and automatically modifying data on the graphs and vice versa.



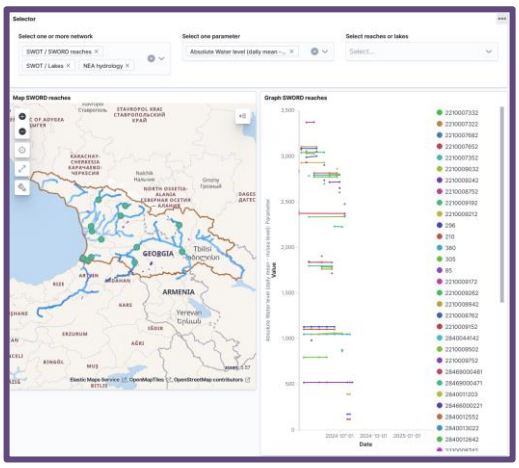


Figure 65: Example of data visualisation through dashboard in Georgia

3.5. Ukraine

3.5.1. Analysis of the Institutional framework

The mapping of the main institutions/organizations producing/managing and/or using data related to the environment in Armenia is presented below.

A list of these institutions is available online at: https://www.euwipluseast.eu/en/partners-countries-activities-ukraine/ukraine/iwrm-actors

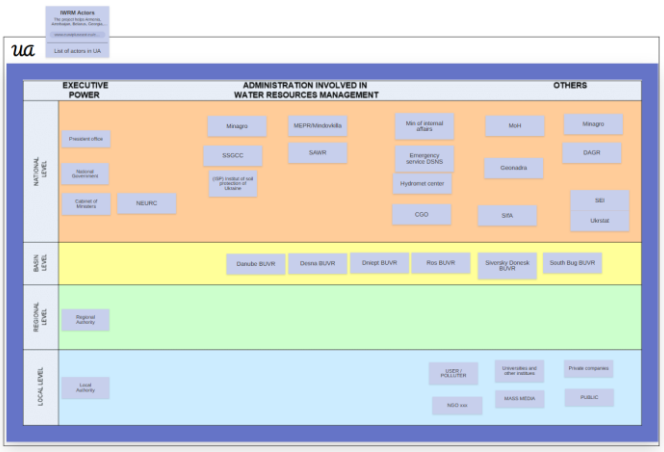


Figure 66 Mapping of the main institutions/organizations in Ukraine

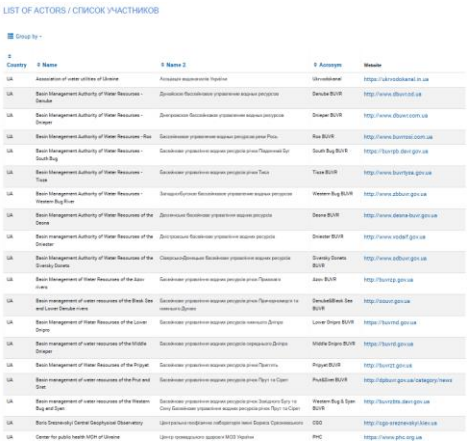


Figure 67 list of the main institutions /organizations in Ukraine

3.5.2. Stimulating the production of metadata

A contract has been signed with a local expert to support the production of metadata in Ukraine. The metadata produced was then verified, translated into English/Ukrainian, and then imported in order to be available in the online catalog available on the OiEau server at the following address: https://www.aquacoope.org/cat_eecca/ukraine/eng/catalog.search#/search

The diagram below shows the number of sources given by type available in the online catalog as well as a screenshot of the online metadata consultation page.

Figure 68: Number of data sources by type described in the Ukrainian metadata

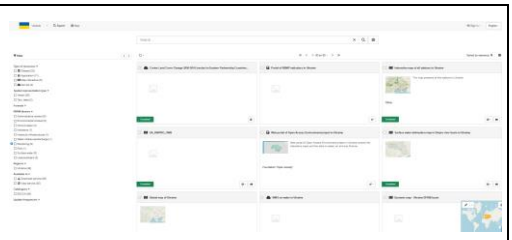


Figure 69: Screenshot of the online metadata page

3.5.3. Development of the e-monitoring information and analytical system for state agency for water resources in Ukraine (with development of APIs)

On the request of the Ukrainian State Agency of Water Resources depending from the Ministry of the environment, a tender was launched in order to improve the monitoring database with development of APIs giving access to the corresponding datasets.

The contract aimed mainly to update a previously existing database application as well as developed new API.

The realization of this contract was a long process requiring the following activities:

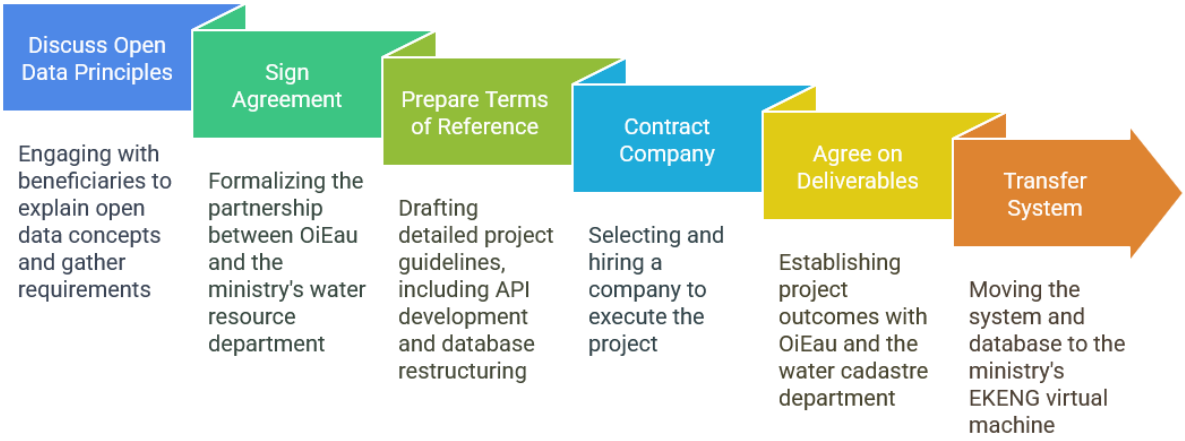


Figure 70: Main steps for the contract development

The reports of the consultant on this activity are available here: Link to the deliverables

The API developed are particularly used when calling data for visualization such as below

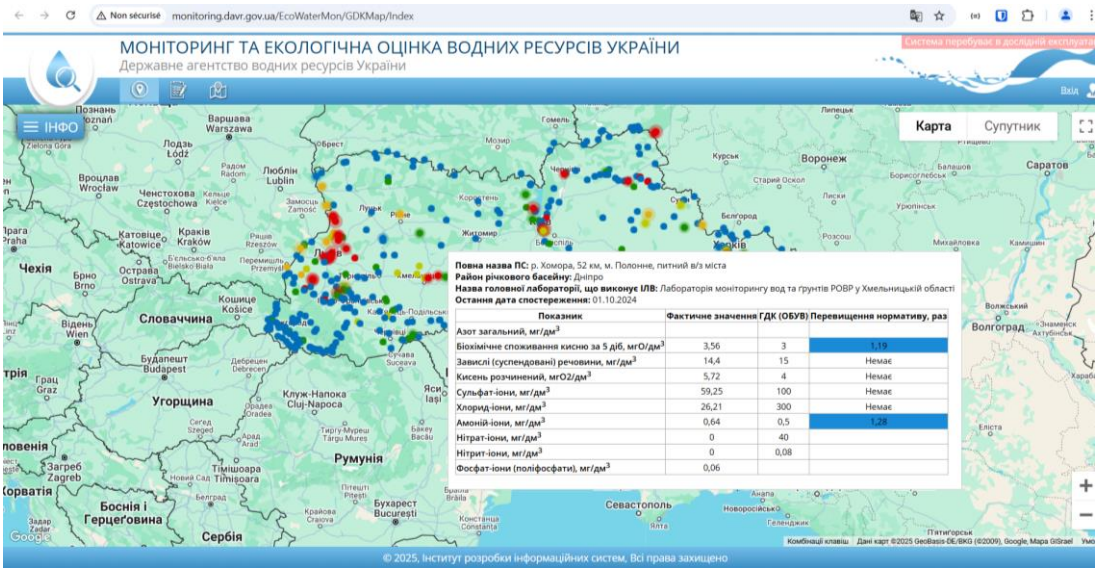


Figure 71: Application for visualisation of surface water quality database in Ukraine

3.5.4. Developing database and web services for data integration and processing

In order to demonstrate the possibility of data integration and visualization, a Postgres geodatabase was developed. As example, this database integrate the characteristics of various monitoring networks and stations and to integrate data coming from these monitoring networks

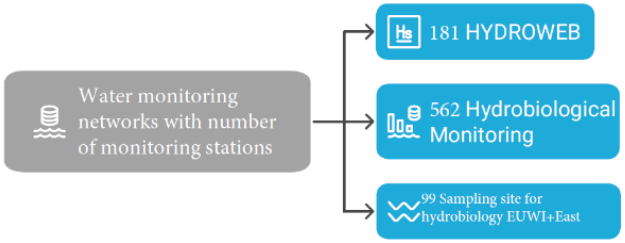


Figure 72: Diagram showing the number of monitoring stations for each network in the database

In addition, a set of geographical layers has been integrated into the Postgres database and made available through the geographical layer server "Geoserver", in the form of WMS and WFS web services.

More than 25 layers were published in WMS service allowing to create the interactive maps combining different WMS / WFS services locally or directly in the metadata catalogue

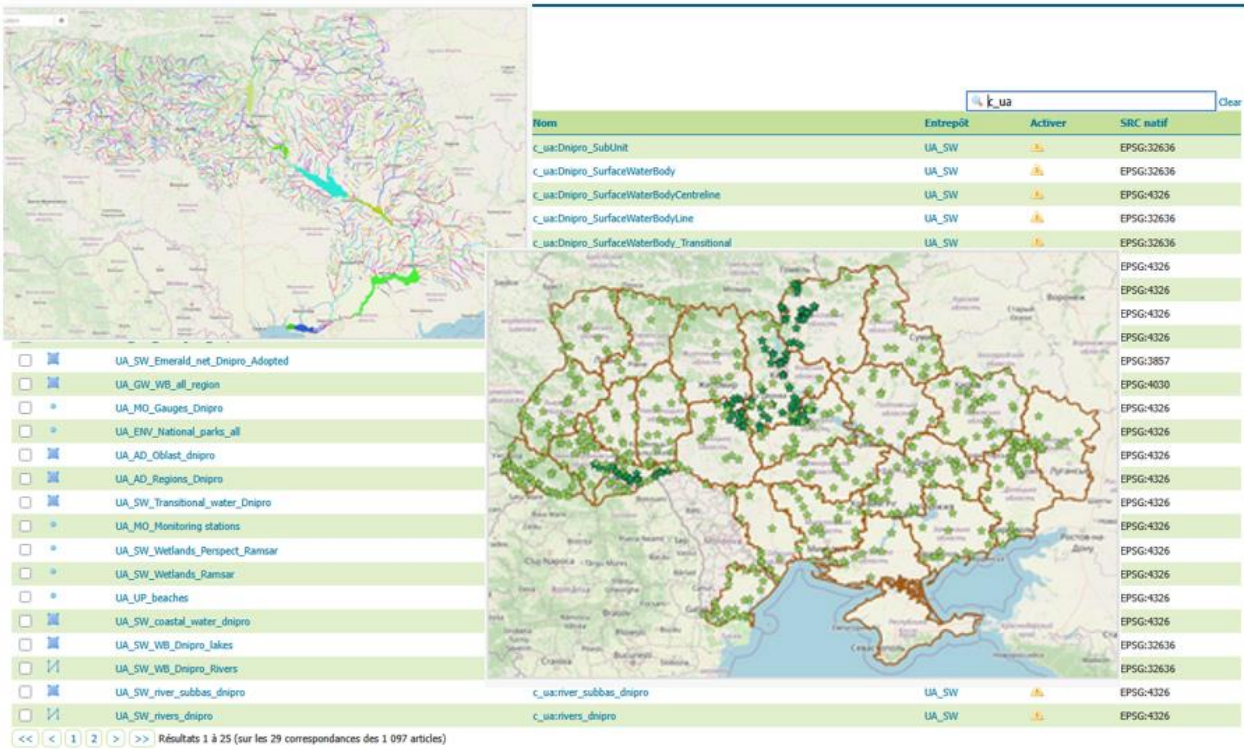
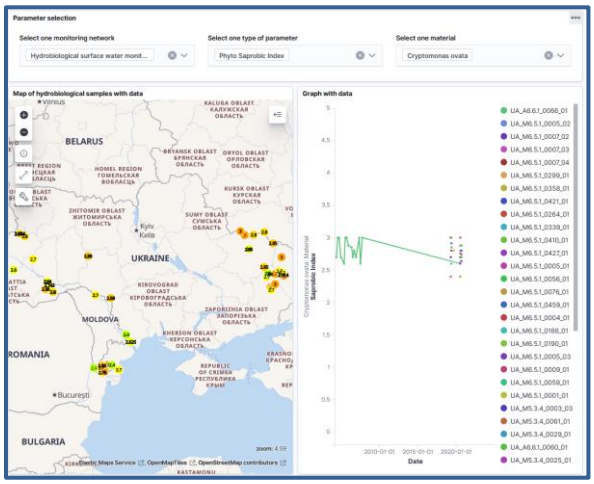


Figure 73: Examples of web services and dynamic maps produced using web services

3.5.5. Developing data visualization products

In addition to dynamic maps, the web services and the database offer the possibility of developing interactive dashboards such as those presented below. These dashboards allow interaction between the map and the graphs, for example, by selecting objects on the map and automatically modifying data on the graphs and vice versa.



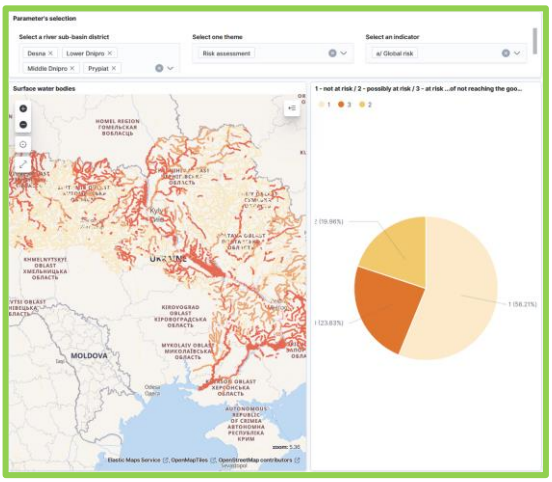


Figure 74: Example of dashboard in Ukraine

4. Main results and recommendations per country

For each country this chapter presents a scheme summarizing the progress and potential actions through a long term vision of an optimal national environmental data management as well as some recommendation for next steps.

4.1. Armenia

This scheme summarize the progress and potential actions through a long term vision of an optimal national environmental data management in Armenia

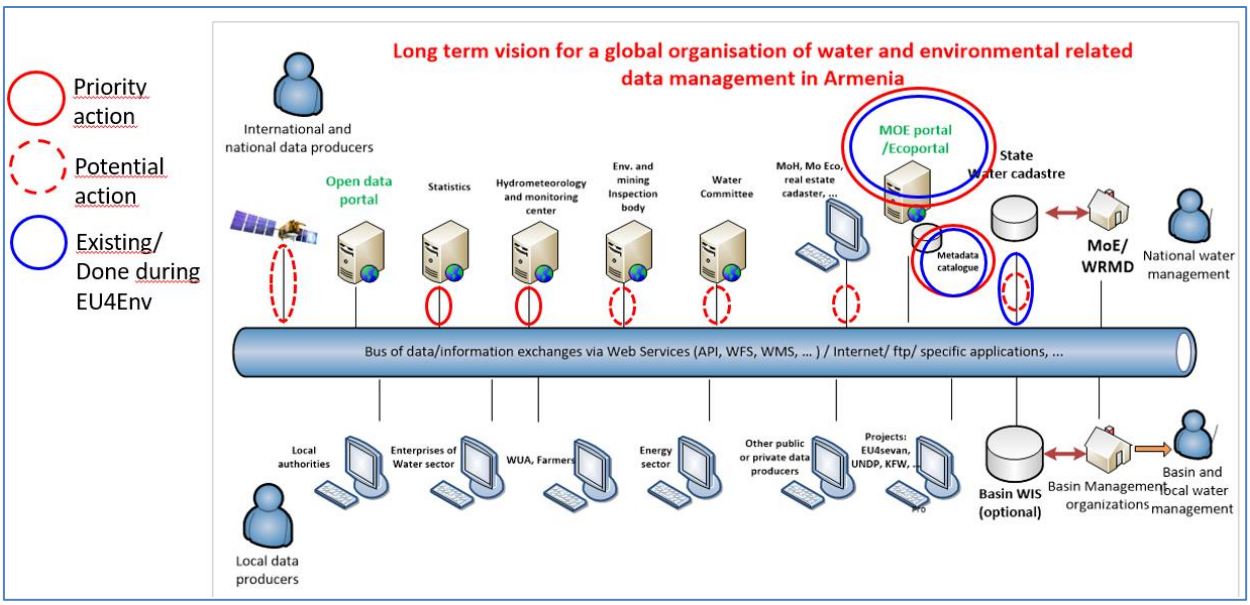


Figure 75: Progresses and potential actions through a long term vision of an optimal national environmental data management in Armenia

 # Recommended for future actions in Armenia

The following actions are recommended to reinforce the environmental data management in Armenia:

- Developing the data governance framework promoting the definition and implementation of an inter-institutional water data governance framework with link to E government portal: https://www.e-gov.am/en/
- Reinforcing main entry point for data access promoting the Ecoportal as entry points portal
- Finalizing the transfer of platform components from OiEau server to Armenian servers
- Supporting complementary metadata production
- Reinforcing the national water information systems facilitating their interoperability with API/Web services in particular concerning the access to the Statistics datasets, the 2TP datasets (water use declaration), and in Exploiting the expected API from hydromet
- Supporting the water cadastre data dissemination products
- Supporting national reporting processes (EEA, …)

4.2. Azerbaijan

This scheme summarize the progress and potential actions through a long term vision of an optimal national environmental data management in Azerbaijan

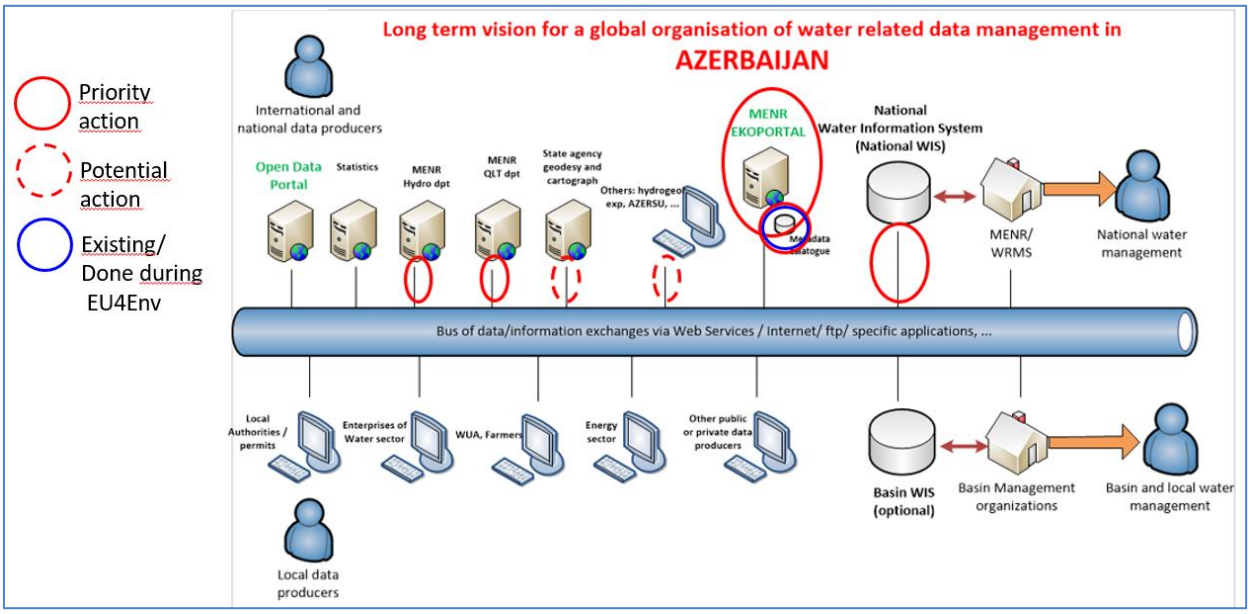


Figure 76: Pprogresses and potential actions through a long term vision of an optimal national environmental data management in Azerbaijan

 # Recommended for future actions

The following actions are recommended to reinforce the environmental data management in Azerbaijan:

- Developing the data governance framework promoting the definition and implementation of an inter-institutional water data governance framework with link to the national open data portal
- Reinforcing main entry point for data access prompting the Ekoportal as entry points portal
- Finalizing the transfer of platform components from OiEau server to servers in Azerbaijan
- Supporting complementary metadata production
- Reinforcing the national water information systems facilitating their interoperability with API/Web services in particular concerning the hydrological datasets and the surface water quality datasets
- Supporting national reporting processes (EEA, …)

4.3. Moldova

This scheme summarize the progress and potential actions through a long term vision of an optimal national environmental data management in Moldova:

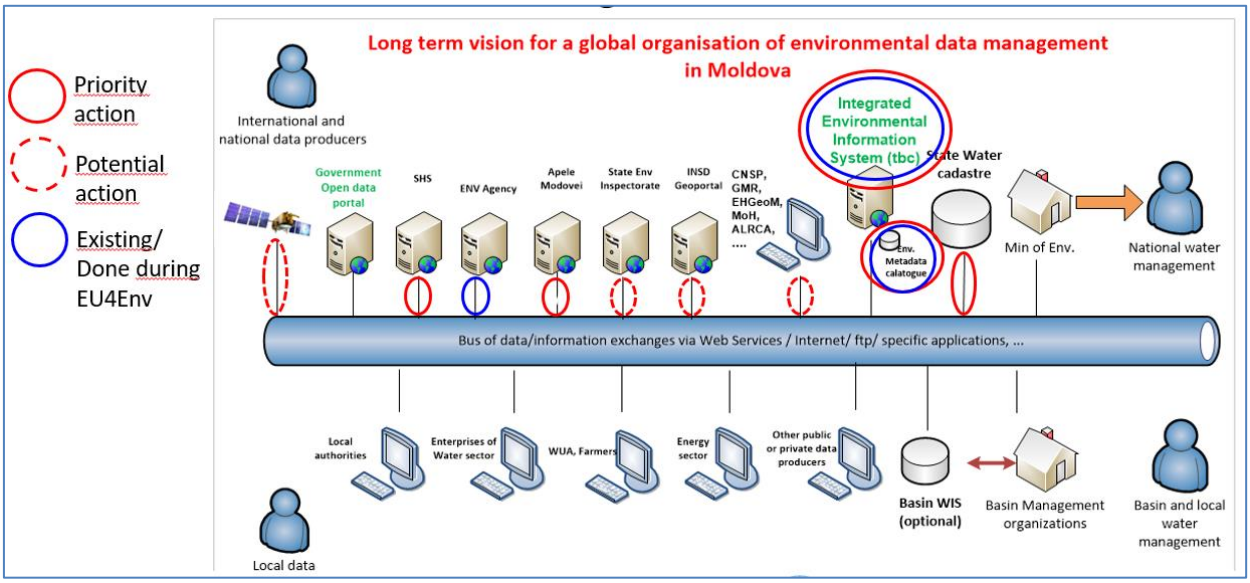


Figure 77: Progresses and potential actions through a long term vision of an optimal national environmental data management Moldova

 # Recommended for future actions

The following actions are recommended to reinforce the environmental data management in Moldova:

- Developing the data governance framework promoting the definition and implementation of an inter-institutional water data governance framework with preparation of a concept note related to Integrated Environmental Information System (IEIS)
- Supporting the implementation of the pilot IEIS Web portal
- Finalizing the transfer of platform components from OiEau server to servers in Moldova
- Supporting complementary metadata production
- Reinforcing the national water information systems facilitating their interoperability with API/Web services in particular concerning the hydrological datasets managed by SHS and the groundwater datasets
- Supporting national reporting processes (EEA, …)

4.4. Georgia

This scheme summarize the progress and potential actions through a long term vision of an optimal national environmental data management in Georgia:

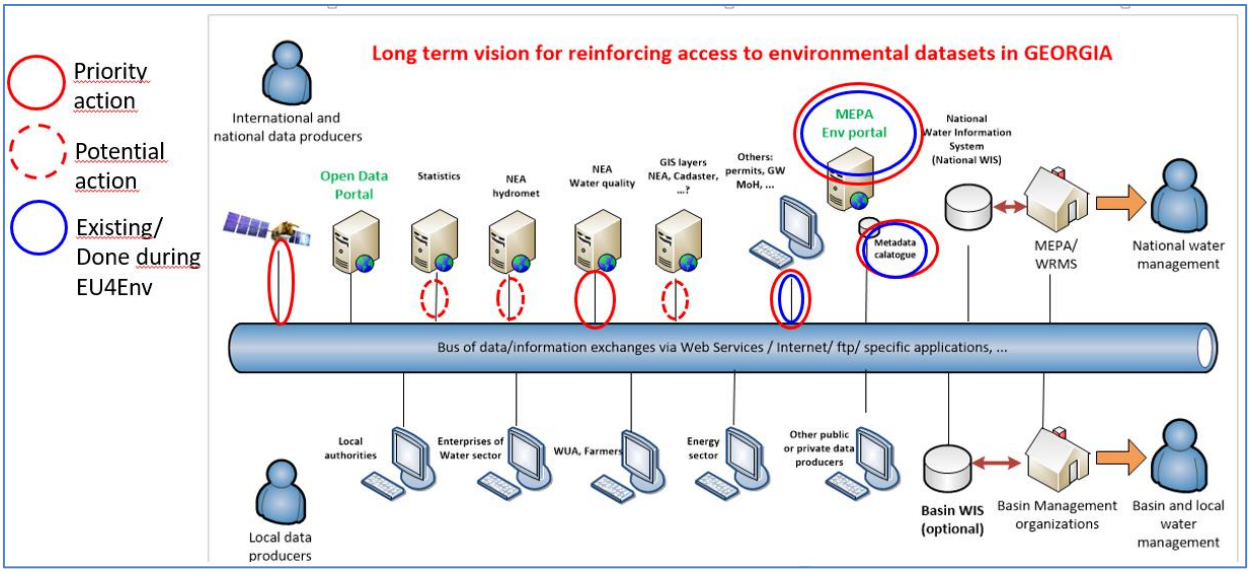


Figure 78: Progresses and potential actions through a long term vision of an optimal national environmental data management in Georgia

 # Recommended for future actions

The following actions are recommended to reinforce the environmental data management in Georgia:

- Developing the data governance framework promoting the definition and implementation of an inter-institutional water data governance framework
- Supporting the implementation of a portal as main entry point for data access
- Finalizing the transfer of platform components from OiEau server to servers in Georgia
- Supporting complementary metadata production
- Reinforcing the national water information systems facilitating their interoperability with API/Web services in particular concerning the hydrological datasets managed by NEA and the surface water quality datasets
- Exploiting the satellite images to produce surface water quality data
- Supporting national reporting processes (EEA, …)

4.5. Ukraine

This scheme summarize the progress and potential actions through a long term vision of an optimal national environmental data management in Ukraine:

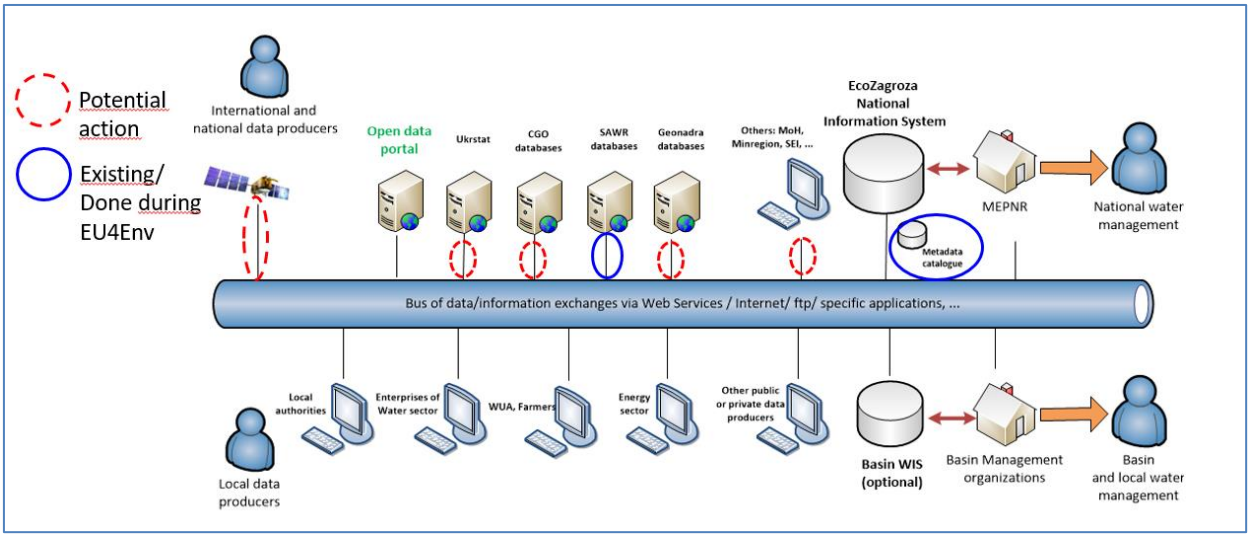


Figure 79: Progresses and potential actions through a long term vision of an optimal national environmental data management in Ukraine

 # Recommended for future actions

The following actions are recommended to reinforce the environmental data management in Ukraine:

- Developing the data governance framework promoting the definition and implementation of an inter-institutional water data governance framework
- Supporting the implementation of a portal as main entry point for data access
- Supporting complementary metadata production
- Reinforcing the national water information systems facilitating their interoperability with API/Web services in particular concerning Water Quality Monitoring Systems and Digital Platforms:
- Exploiting the satellite images to produce complementary surface water quality data
- Supporting national reporting processes (EEA, …)

5. Conclusion

The EU4Environment Water Data Management Initiative has significantly contributed to strengthening data governance and accessibility across Eastern Partnership (EaP) countries.

The table below underline that all the target indicators concerning the output 2.4 on environmental open data development were reached.

Output 2.4	Open data and citizens' participation in data collection and analysis are further operationalised
Indicators	1. No. of countries that made progress on the implementation of the open data roadmaps 2. No. of additional countries that made progress with online access to datasets (as integration is a 2nd priority) 3. 3. No. of countries that took additional measures to improve citizens participation in data collection and analysis
Baseline	1. 0 2. 0 3. 0
Target (2024)	1. 5 with progress on some of the roadmap recommendations 2. 3 3. 2
Progress during EU4ENV	1. 5 with progress on some of the roadmap recommendations 2. 4 with progress with online access to datasets (AM, MD, GE, UA) 3. 2 Hackathon (AM and MD)

Figure 80: Table of the output 2.4 indicators

Despite the progresses, challenges remain particularly due to legal and institutional barriers and to the limited technical and financial capacities.

Taking into consideration these challenges, the recommendations outlined in this report provide a country-by-country roadmap for future actions (as example for the EU4Green initiative) for strengthening environmental data management in the Eastern Partnership (EaP) region through actions aiming to:

- Develop an inter-institutional water data governance framework in each country
- Reinforce main entry point for environmental data access
- Support complementary metadata production
- Reinforce the national water information systems facilitating their interoperability with the main entry point portal through API/Web services
- Leverage Remote Sensing
- Support national reporting processes (EEA, …)

Moving forward, sustained cooperation, technological advancements, and policy integration will be key to ensuring the long-term success of these efforts, promoting a shared long-term vision focused on improving data governance, infrastructure, accessibility, and interoperability, in line with the European directives

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