



Deliverable

Definition of requirements to GIP following recommendations from the GIP project

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GENERAL INTRODUCTION

This technical note describes the requirements and requests for EGDI functionality for data delivered from each TACTIC work package to the GeoERA Information Platform (EGDI) in order to efficiently visualize data and make data accessible according to the FAIR (Findable, Accessible, Interoperable and Reusable) principles of Horizon 2020.



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0 SUMMARY

List of products produced by TACTIC. The number assigned to each product is used throughout the document to facilitate the compression of the information associated with each product.

Workpackage	Number of the product	Title and description
All WP	1	Pilot study reports
	2	On-line dynamic sensor measurements of changes e.g. in water table (WT) and electrical conductivity (EC)
WP3	3	Groundwater table changes in Europe
	4	Water balance changes in Europe
WP4	5	Pan European net-precipitation map (T4.6, D4.4)
	6	Recharge values at selected locations
	7	Schematics showing time variant recharge values and uncertainty analysis over selected period (Static)
	8	Map displaying aquifer vulnerability to climate change (D4.2)
	9	Schematics showing time variant recharge values and uncertainty analysis over selected period (Dynamic)
	10	Statistical values at selected points
WP5	11	Schematics showing groundwater level values and trends over selected period (Static)
	12	Geological 3D model from Emilia Romana
	13	Pilots description and assessment report for sea/salt water intrusion
	14	Journal papers
WP6	15	Report from all the WP5 tasks (Technical note of the method to assess seawater intrusion & Guideline for WP5)
	16	Pilots description and assessment report for adaptation
	17	Journal paper
	18	Report from all the WP6 tasks (Development of climate change projections and adaptation scenarios & Guideline for WP6)

The below table summarizes some of the characteristics that allows to have a quick overview about the type of products that TACTIC will make accessible through the EGDI platform. A more extensive information on each product is provided in the sections dedicated to each work package.



	Product number	Product Type		Spatial dimension	Projection system.	Delivery Format to EGDI			Metadata:	
		Structured Data	Unstructured data			OGC web services	Uploading GIS files	Unstructured data	Metadata provider	Metadata collection
All WP	Nº1	Vector	X	several geometries	As requested by GIP based on standardized projection systems	Preferably at least examples of all these as we need to demonstrate FAIR data access	Shape-files, GRID, GIS, ESRI, QGIS, shp files, ASCII	PDF reports and figures should generally be georeferenced and/or linked to the georeference pilots	All partners	Both
	Nº2	Vector		Point (xyz)	As requested by GIP based on standardized projection systems	WFS/WCS? - Time series need to be downloadable as JSON and CSV files	JSON (existing SGU format? Or harmonized SGU & GEUS formats		Involved partners	Both
WP3	Nº3	Raster	X	varying	EPSG:4326 (WGS84).		GeoPackage	PDF	All partners in WP3	Direct editing
	Nº4	Vector	X	Point or polygon	EPSG:4326 (WGS84).		Esri shape files	PDF, JPG, TXT	All partners in WP3	Direct editing
WP4	Nº5	Raster		Grid with 1-5 km square cells	WGS_1984_Web_Mercator_Auxiliary_Sphere EPSG: 4326 (WGS84).	WFS/WCS	GeoPackage		GEUS/GeoERA partners	Direct editing
	Nº6-	Vector		Point or polygons	WGS_1984_Web_Mercator_Auxiliary_Sphere EPSG: 4326 (WGS84).	WMS	GeoPackage		GeoERA partners	Direct editing
	Nº7-	Vector	X	Point	WGS_1984_Web_Mercator_Auxiliary_Sphere. EPSG: 4326 (WGS84).	WMS		PDF or JPEGs	GeoERA partners	Direct editing
	Nº8)	Raster		Not yet defined	WGS_1984_Web_Mercator_Auxiliary_Sphere. EPSG: 4326 (WGS84).	WMS	GeoPackage		GeoERA partners	Direct editing
	Nº9	Vector		Points	WGS_1984_Web_Mercator_Auxiliary_Sphere. EPSG: 4326 (WGS84).	WMS	GeoPackage		GeoERA partners	Harvesting
	Nº10	Vector		Points	WGS_1984_Web_Mercator_Auxiliary_Sphere. EPSG: 4326 (WGS84).		GeoPackage		GeoERA partners	Direct editing
	Nº11	Vector	X	Points	WGS_1984_Web_Mercator_Auxiliary_Sphere. EPSG: 4326 (WGS84).	WMS		PDF or JPEGs	GeoERA partners	Harvesting or direct editing



WP5	Nº12	3 D model(vector , raster, and table)	X	XYZ points, 3D polylines, 3D polygons, 3D meshes (volumes)	EPGS 5659	For 2D data: WMS, WFS	ESRI shapefile	PDF	For 2Ddata: CSW http://geoportal.emilia-romagna.it/reader_csw/	harvesting
	Nº13	Vector	X	Polygons	EPGS 5659		ESRI Shapefile	PDF	All partners in WP5	Direct editing
	Nº14-		X					PDF autor copy	IGME and other partners and 3 rd parties contributions to the WP	Direct editing
	Nº15		X					PDF	All partners in WP5	Direct editing
WP6	Nº16	Vector	X	Polygons	EPSG 4326		ESRI Shapefile	PDF	Direct editing	Direct editing
	Nº17		X					PDF autor copy	IGME	Direct editing
	Nº18		X					PDF	All partners in WP5	Direct editing



The following table summarise the functionalities requested by the different products.
Note that the number and name of the functionality correspond to the ones existing in appendix II table.

Nr	Functionalities	number of times requested	number of the product which requested it
1	Search based on location	13	nº3, nº4,nº5,nº6,nº7,nº8,nº9,nº10,nº11,nº13,nº14,nº15,nº16
2	Search documents	4	nº13,nº16,nº17,nº18
4	Interface to upload and thematise GeoPackage	2	nº3, nº4,
5	Enhanced interface to upload and thematize Shapefiles	2	nº3, nº4,
7	Web page with all services	9	nº3, nº4,nº5,nº6,nº7,nº8,nº9,nº10,nº11
9	Download data (no access control)	12	nº2, nº3, nº4,nº5,nº7,nº11,nº13,nº14,nº15,nº16,nº17,nº18
10	Identify+follow link	5	nº2, nº3, nº4,nº7,nº11
12	overview panel	4	nº3, nº4,nº5,nº8,
13	Legend with tree view / hierarchical on/off switching	4	nº3, nº4,nº13,nº16
14	Export map	10	nº3, nº4,nº5,nº6,nº7,nº9,nº10,nº11,nº13,nº16
16	Display a graph with time series data (piezo levels, rain....)	2	nº2, nº9
17	Multiscaling	6	nº3, nº4,nº5,nº6,nº9,nº10
18	Transparency	1	nº8,
30	Handling and displaying 3D models	1	nº12
34	Virtual cross section	1	nº12



1 INTRODUCTION

The requirements from the TACTIC project to the GIP-P project regarding the contents and functionality of the GeoERA Information Platform / European Geological Data Infrastructure (EGDI) have to be clearly defined in order to develop a common understanding of the information products delivered from TACTIC to EGDI and further to all relevant stakeholders. These requirements are very important in order to ensure that we make TACTIC data and tools of relevance to sustainable management of water resources in Europe and EU policy in general “FAIR” (Findable, Accessible, Interoperable and Reusable) according to guidelines of the European Commission.

The mission of TACTIC is to provide important data and tools for assessment of climate change impact on groundwater and adaptation strategies. The data and tools provide important information for groundwater status assessments and projections of the evolution of groundwater quantity and quality in a future climate and hereby contribute to safeguarding Europe’s water resources.

This report describes the requirements from all technical work packages in TACTIC and include information of relevance to mainly groundwater quantity issues. However, saltwater intrusion in coastal aquifers, which have a significant impact on available freshwater resources in coastal regions is also included (WP5).



2 INSTRUCTIONS FOR COMPLETING THE DIFFERENT SECTIONS

This section provides clarifications on some of the different sections to be completed by each work package leader for each of the products and the desired requirements/functionalities linked to each of the products.

2.1 Description of the products

The description of the results/products that each work package will deliver to the EGDI platform is done by means of a table. Each column represents a product (e.g. Pan-European net-precipitation map, report associated with Pan-European net-precipitation map, hydrological properties database, etc.). Rows provide information on the type of data produced by each work package and the delivery format. In the following list, brief instructions are provided on how to complete the rows of the table. Fields in bold must be completed, as this is necessary information for the GIP-P project to evaluate the products.

- **Title and brief description:** – in order to identify the topic in which the product belongs to, a title and a brief description are requested.
- **Product Type:** specify with an "X" whether the product is a structured data (database, 2D and 3D georeferenced information, project vocabulary etc.) or unstructured data, (PDF, photos, scanned downhole logs, etc). Note that a product can have both type of information (e.g.: a borehole database where some records have a scanned log).
- **Data sources:** specify where the data come from in case you want to track the sources.
- **Spatial dimension:** to complete only for georeferenced information. Specify the geometry of the product, e.g.: point, line, polygon, Point Cloud, 2.5D surface etc. Note that a product may have several geometries
- **Temporal dimension:** to complete only for georeferenced information. Specify with an "X" whether the product is static or dynamic. If it is dynamic, specify if it implies "real time" or not.
- **Scale:** to complete only for georeferenced information. Specify, whenever it makes sense, the scale that is suitable for the data (e.g.: 1:1.000.000 or 1:100,00 - 50,000 etc.).
- **Coverage:** Specify the coverage of the product. (e.g. Pan European, transboundary, national, etc.)
- **Projections system:** to be complete for georeferenced information. Specify the projection system of the product by means of an EPSG code. A list of the EPSG code can be found in the following link <http://spatialreference.org/ref/>. EGDI already supports EPSG 4326 (WGS84 lat/long) and EPSG 3034 (ETRS89/ETRS-LCC). The support of EPSG 3035 (Lambert Azimuthal Equal Area, made for statistics and preserving areas) is being evaluated.
- **Delivery Format to EGDI:** specify the format that data are going to be supplied to EGDI taking in account the following information.

For structured data, there are two main ways for providing data to EGDI: OGC web services and uploading GIS files. GIP-P project encourages GeoERA Scientific Projects to provide data through OGC web services. A list of OGC web services identified by WP3 GIP-P project can be found in Appendix I, please choose from the list the one that best fits that best fits the provider organization and the data. If you decide, providing data by uploading GIS files only two formats are supported by EGDI: ESRI Shapefile or GeoPackage (<https://www.opengeospatial.org/standards/geopackage>). Please specify the chosen format.

For unstructured data, please specify the format of the file delivered to EGDI.



For 3D data, if your organization is considering to delivering data using a proprietary format, please specify which one. Take in account that at this stage, GIP-P project cannot guarantee that all proprietary 3D formats will be supported.

- **Metadata**: Please identify the organization providing the metadata of the product and how the metadata will be collected:
 - Harvesting: it implies that the product metadata file is located in a metadata catalogue different from the EGDI metadata catalogue (MICKA) and it will be harvested following the instruction given by GIP-P. This option is the one recommended by GIP-P project to ensure up-to-date and quality metadata.
 - Direct editing: it implies that the metadata file is located in the EGDI metadata catalogue and will be completed directly in the EGDI metadata catalogue following GIP-P instructions.

2.2 Description of attributes for each product

This section needs to be complete only if the product type is structured information.

In case the product is a database, include in this section the data model and/or any documentation that describes the existing tables and relationships in the database (UML diagram, screen shot of the database diagram etc.). If the database follow any existing standardize data model please specify which one (INSPIRE theme model, GeoSciML, Groundwater ML2 etc). In case the product are GIS files, specify in a table (already included) for each product, the name of the attribute, a brief description, the format (number, text, etc.) and the units of measure (if applicable). If the product has multiple layers of information, use different table for each layer of information.

2.3 Use case and requirements associated to each product

- **Use case section**: Please describe a brief use case of each product. Briefly describe how an end user would interact with the product. If there is an information system or a platform already existing that can be used as an example of a use case, please include the link to the website. The purpose of this section is to have a better understanding of the requirements/functionalities requested in the following section.
- **Requirements**: functionalities or requirements that end users need to interact with the product.

For each product, complete the table included in this section. The number, name and description of the requirement **has to be selected from the appendix II table**. Note that EGDI already has developed functionalities (see <http://www.europe-geology.eu/map-viewer/>). The ones listed in appendix II are extensions to be developed according to project requirements. A product may have several associated requirements and they have to be connected with the use case described in the use case section. When choosing the functionalities take into account that some of them are indicated as high priority and others as very complex to be developed during the course of GeoERA.



3 DATA TYPES FOR EGD FROM AND POTENTIALLY RELEVANT FOR ALL TACTIC WORK PACKAGES

3.1 Description of the products

Title and description		Nº1-Pilot study reports	Nº2-On-line dynamic sensor measurements of changes e.g. in water table (WT) and electrical conductivity (EC) (point)
Product Type	Structured Data (Vector, raster, etc)	X (vector)	X (vector)
	Unstructured data	(X)	
Data sources		Report contribution from partners	On-line sensors installed by partners and possibly 3 rd parties like EPA's?
Spatial dimension		Several geometries	Point (xyz)
Temporal dimension	static	Yes	No
	dynamic: real time (yes/no)	No	Yes (near real-time)
Scale		varying	varying
Coverage		Sites in countries participating	Local sites / wells within pilots
Projection system.		As requested by GIP based on standardized projection systems / GeoERA standard	As requested by GIP based on standardized projection systems
Delivery Format to EGD	OGC web services (WMS, WFS, WCS, etc.)	Preferably at least examples of all these as we need to demonstrate FAIR data access	WFS/WCS? - Time series need to be downloadable
	Uploading GIS files (ESRI shapfiles or GeoPackage.)	Shapefiles or GeoPackage files defining pilot areas (already established and shown on TACTIC website)	JSON (possibly SGU standard or harmonized SGU & GEUS standards)
	Unstructured data (PDF, JPG; TXT, etc.)	PDF reports and figures should generally be georeferenced and/or linked to the georeference pilots	None
Metadata:	Metadata provider (IGME, GBA etc.)	All partners	Involved partners
	Metadata collection (Harvesting/direct editing)	Direct editing	Direct editing (and harvesting?)

3.2 Description of attributes for each product

3.2.1 N°2-On-line dynamic sensor measurements of changes e.g. in water table (WT) and electrical conductivity (EC)

Layer 1

Name of the attribute	Description	Unit	Data type
Groundwater level	Elevation of water table	m	integer
Temperature (T)	Groundwater temperature	Degrees Celsius	integer
Electrical conductivity	Specific electrical conductivity (at 25 C)	uS/cm	integer



Chloride	Cl concentration	Mg/l	integer
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3.3 Use case and requirements associated to each product

3.3.1 Use case.

3.3.1.1 N°1-Pilot study reports

End users can access and download pilot study reports from GeoERA / EGDI repositories via the pilot area maps provided on the TACTIC website and in EGDI, keywords and free text searches.

3.3.1.2 N°2-On-line dynamic sensor measurements of changes e.g. in water table (WT) and electrical conductivity (EC)

End users can access, visualize and download time series of water tables, electrical conductivity, temperature and possibly other parameters from the website. The website functionality already exists at SGU and the EGDI version is expected to be based on that. The SGU website will be updated in 2020 and SGU and GEUS has agreed to use this as the basis for the EGDI website. The SGU site currently just provide time series on water tables but the functionality will be extended to include other parameters (temperature, EC, etc.).

3.3.2 Requirements

Product title	Nr	Requirement	Description
N°1-Pilot study reports	2		PDF reports accessible (see above)
	9		Reports can be downloaded
N°2-On-line dynamic sensor measurements of changes e.g. in water table (WT) and electrical conductivity (EC)	7		Functionality as in new version of SGU website, but with additional sensor data
	9		Data can be downloaded in JSON and CVS and a API provided?? By all (no access control)



4 DATA FOR EGDI FROM WP3

4.1 Description of the products

Title and description		N°3-Groundwater table changes in Europe	N°4-Water balance changes in Europe
Product Type	Structured Data (Vector, raster, etc)	X raster	X vector
	Unstructured data	X	X
Data sources		Model output from partners	Model output from partners
Spatial dimension		varying	Point or polygon
Temporal dimension	static	Yes	Yes
	dynamic: real time (yes/no)	No	No
Scale		varying	varying
Coverage		Pilots in participating countries in WP3	Pilots in participating countries in WP3
Projection system.		EPSG:4326 (WGS84).	EPSG:4326 (WGS84).
Delivery Format to EGDI	OGC web services (WMS, WFS, WCS, etc.)		
	Uploading GIS files (ESRI shapfiles or GeoPackage.)	GeoPackage	Esri shape files
	Unstructured data (PDF, JPG; TXT, etc.)	Yes, PDF	Yes, pdf, jpg, txt
Metadata:	Metadata provider (IGME, GBA etc.)	All partners in WP3	All partners in WP3
	Metadata collection (Harvesting/direct editing)	Direct editing	Direct editing

4.2 Description of attributes for each product

4.2.1 N°3-Groundwater table changes in Europe

Below attributes is a different raster for each attribute. Each attribute can have several periods.

Name of the attribute	Description	Unit	Data type
Groundwater table reference	Groundwater tables during a reference period	masl	Number
Groundwater table future	Groundwater tables for a future temperature change of +1 or +3 degree C	masl	Number
Changes of groundwater table	Changes in groundwater tables between a future and a reference period	m	Number

4.2.2 N°4-Water balance changes in Europe

Name of the attribute	Description	Unit	Data type
Water balance parameters volume	Water balance parameters in units of volume per time unit	m3/sek	Number



Water balance parameters area	Water balance parameters in units of length per time	mm/yr	Number
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4.3 Use case and requirements associated to each product

4.3.1 Use case.

4.3.1.1 N°3-Groundwater table changes in Europe and Water balance changes in Europe

Groundwater table, changes of groundwater table and changes of water balance for different time slices and changes between a present (reference period) and future period or a relative temperature rise. For instance, there can be a groundwater level map for a future period with a temperature change of +3 degrees Celsius and there can be a change, spatial dataset between the reference period and the future period with a +3 degrees Celsius change.

Reports (unstructured data documents the groundwater table or groundwater table change) will be attached to the two product. Reports documenting related issues of climate change or global change impacts on groundwater.

4.3.1.2 N°4-Water balance changes in Europe

The data describe relevant water fluxes in either as point data or data representing a polygon



4.3.2 Requirements for both products in WP3:

Product title	Nr	Requirement	Description
Nº 3-Groundwater table changes in Europe & N°4-Water balance changes in Europe	1	Search based on location	This search is intended to work either by entering an address, city or geographical coordinates. Zoom to the location will occur when pressing enter.
	4	Interface to upload and thematise GeoPackage	
	5	Enhanced interface to upload and thematize Shapefiles	
	7	Web page with all services	A viewer where each project can see all the web map services that the project decides to show. It consists of a webpage with a list of all services comprised in the platform, including both the services directly available from EGD platform and those drawn from the thematic projects The basemap should be topographic. https://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2
	9	Download data (no access control)	Open access to a documents/data repository.
	10	Identify+follow link	The user can click on a link to access documents or url. The files must be stored in the repository+ metadata.
	12	overview panel	There should be a 1: 5,000,000 overview
	13	Legend with tree view / hierarchical on/off switching	It will be possible to display different fields e.g. different climate change scenarios used. Those will be individually visualized.
	14	Export map	export composition displayed in the viewer to PDF or JPG file; scale and arrow indicating north should be included, option to choose also a georeferenced image for download.
	17	Multiscaling	Reference scale 1:1,500.000



5 DATA FOR EGDI FROM WP4

5.1 Description of the products

Title and description		Nº5-Pan European net-precipitation map (T4.6, D4.4)	Nº6-Recharge values at selected locations	Nº7-Schematics showing time variant recharge values and uncertainty analysis over selected period (Static)	Nº8-Map displaying aquifer vulnerability to climate change (D4.2)	Nº9-Schematics showing time variant recharge values and uncertainty analysis over selected period (Dynamic)	Nº10-Statistical values at selected points	Nº11-Schematics showing groundwater level values and trends over selected period (Static)
Product Type	Structured Data Vector / raster	XY Raster	XY vector	XY vector	XY Raster	XY vector	XY vector	XY vector
	Unstructured data			X				X
Data sources		GeoERA, 3rd party, and partners.	GeoERA partners	GeoERA partners	GeoERA partners	GeoERA partners	GeoERA partners	GeoERA partners
Spatial dimension		Grid with 1-5 km square cells	Point data or polygons	Plots at point data	Gridded raster data	Plots at point data	Point data	Plots at point data
Temporal dimension	static	Long term average values	Long term average values	X	X	Long term average values	Statistical values based on long time series	X
	dynamic: real time (yes/no)	Not real time but possibly snapshots of LTA monthly values	Not real time but possibly snapshots of LTA monthly values. Also values for defined future time horizons		Not real time but classes for defined future time horizons	Not real time but possibly snapshots of LTA monthly values. Also values for defined future time horizons		
Scale		Pan-European coverage using a regular grid with 1-5 km square cells	Spot data	Not yet defined	Not yet defined	Not yet defined	Spot data	Not yet defined
Coverage		Pan European	Across Europe but for contributing partners	At selected points	Contributing partners	At selected points / over selected polygons	Across Europe but for contributing partners	At selected points
Projection system.		WGS_1984_Web_Mercator_Auxiliary_Sphere EPSG: 4326 (WGS84).	WGS_1984_Web_Mercator_Auxiliary_Sphere EPSG: 4326 (WGS84).	Plots at points locations of which defined by WGS_1984_Web_Mercator_Auxiliary_Sphere EPSG: 4326 (WGS84).	WGS_1984_Web_Mercator_Auxiliary_Sphere EPSG: 4326 (WGS84).	Plots at points locations or polygon centres defined by WGS_1984_Web_Mercator_Auxiliary_Sphere EPSG: 4326 (WGS84).	WGS_1984_Web_Mercator_Auxiliary_Sphere EPSG: 4326 (WGS84).	Plots at points locations of which defined by WGS_1984_Web_Mercator_Auxiliary_Sphere EPSG: 4326 (WGS84).
Delivery Format to EGDI	OGC web services (WMS, WFS, WCS, etc.)	WFS/WCS? – data need to be downloadable for net precipitation.	WMS	WMS but can be downloadable	WMS	WMS		WMS
	Uploading GIS files (ESRI)	GeoPackage	GeoPackage		GeoPackage	GeoPackage	GeoPackage	



	shapfiles or GeoPackage.)							
	Unstructured data (PDF, JPG; TXT, etc.)			Spatially referenced PDF or JPEGs				Spatially referenced PDF or JPEGs
Metadata:	Metadata provider (IGME, GBA etc.)	GEUS/GeoERA partners	GeoERA partners	GeoERA partners	GeoERA partners	GeoERA partners	GeoERA partners	GeoERA partners
	Metadata collection (Harvesting/direct editing)	Direct editing	Direct editing	Direct editing	Direct editing	Harvesting	Direct editing	Harvesting or direct editing



5.2 Description of attributes for each product

5.2.1 N°5-Pan European net-precipitation map

Main Layer: 13 raster data representing LTA values for each month and LTA values over the selected historical period

Name of the attribute	Description	Unit	Data type
Effective precipitation potential recharge	Water infiltration into the soil zone calculated as rainfall minus actual evaporation	mm/year And mm/month	number

5.2.2 N°6-Recharge values at selected locations

Layer or table: Table of X, Y, name, description of value, and value for different types of LTA recharge values

Name of the attribute	Description	Unit	Data type
X	X coordinate of the point data	m	number
Y	Y coordinate of the point data	m	number
Name	Name of the data point		string
Description	A description defining the properties of the value (Potential, actual GWT, actual GW aquifer, minimum)		string
recharge	Water infiltration as defined in "Description" column	mm/year	number

5.2.3 N°7-Schematics showing time variant recharge values and uncertainty analysis over selected period (Stactic)

Name of the attribute	Description	Unit	Data type
Additional details	A screen shot of complex analysis to be defined later	NA	NA

5.2.4 N°8-Map displaying aquifer vulnerability to climate change

Layer or table: Gridded

Name of the attribute	Description	Unit	Data type
GW vulnerability index (class)	Index of groundwater vulnerability to climate change displayed as classes of vulnerability		integer
GW vulnerability index (change)	Index of groundwater vulnerability to climate change displayed as percentage change		number



5.2.5 *N°9-Schematics showing time variant recharge values and uncertainty analysis over selected period (Dynamic)*

Layer or table

Name of the attribute	Description	Unit	Data type
Additional details	Plot that spawns to show time series of information to be defined later. Zoomable and dynamic	NA	NA

5.2.6 *N°10-Statistical values calculated at selected points*

Layer or table: Table of X, Y, name, description of statistical value and value

Name of the attribute	Description	Unit	Data type
X	X coordinate of the point data	m	number
Y	Y coordinate of the point data	m	number
Name	Name of the data point		string
Description	A description defining the properties of the value (trends, slope etc.)		string
value	Statistical value as defined in “Description” column	mm/year or %	number

5.2.7 *N°11-Schematics showing groundwater level values and trend over selected period*

Name of the attribute	Description	Unit	Data type
Additional details	A screen shot to show GW time series and trends and other information to be defined later.	NA	NA

5.3 Use case and requirements associated to each product

5.3.1 Use case.

5.3.1.1 N°5-Pan European map showing net-precipitation (D4.4)

A map based on gridded ascii data to visualise the net precipitation as calculated by TACTIC partners at national scale, or assessed by satellite data interpretation, made available through EGDI (view and download of gridded data in grid, PDF, or JPGs).

5.3.1.2 N°6-Recharge values at selected locations

At selected locations (boreholes) long term average recharge values, as calculated by the different tools, will be displayed on top of the pan-European recharge map (View only).

5.3.1.3 N°7-2D schematics for time variant recharge values and uncertainty analysis

Time variant recharge plots calculated by the different tools and methods to be shown next to a selected borehole if required. The plot will show time variant recharge for a selected period of

time together with upper and lower bounds defining the uncertainty in the calculated values. (View and possibility to download in PDF format)

5.3.1.4 N°8-Map displaying aquifer vulnerability to climate change

A map based on gridded ascii data and showing classes of vulnerability of recharge to climate change and estimated using index method will be displayed. (View only)

5.3.1.5 N°9-Schematics showing time variant recharge values and uncertainty analysis over selected period (Dynamic)

Time variant recharge plots calculated by the different tools and methods to be shown next to a selected borehole if required. The plot will show time series of information. The plot is dynamic about the selected period displayed. Possibility of extending the displayed data in future. (View and possibility to download in PDF format)

5.3.1.6 N°10-Statistical values at selected locations

At selected locations (wells) statistical values, as calculated by the different tools, will be displayed on top of the vulnerability map (View only).

5.3.1.7 N°11-Schematics showing time variant groundwater level values and trends over selected period (Static)

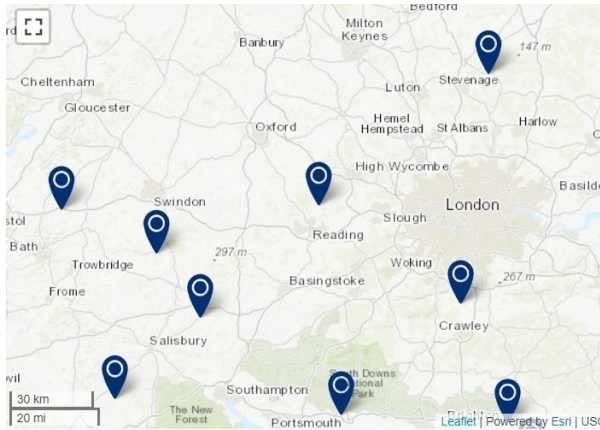
The plot will show time series of information and statistical information like trends. (View and possibility to download in PDF format)

1) 2D MAPS (raster file).



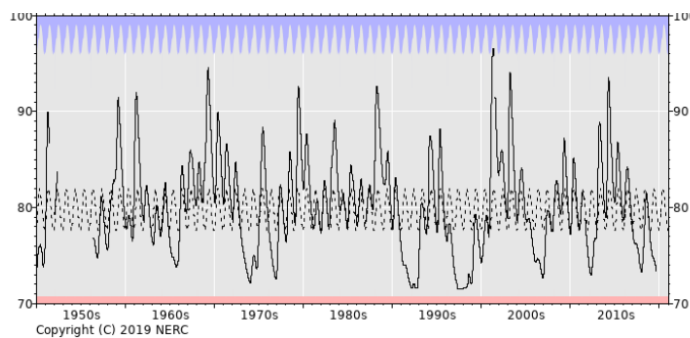
Example of spatially distributed recharge Map (LTA values)

2) Point information



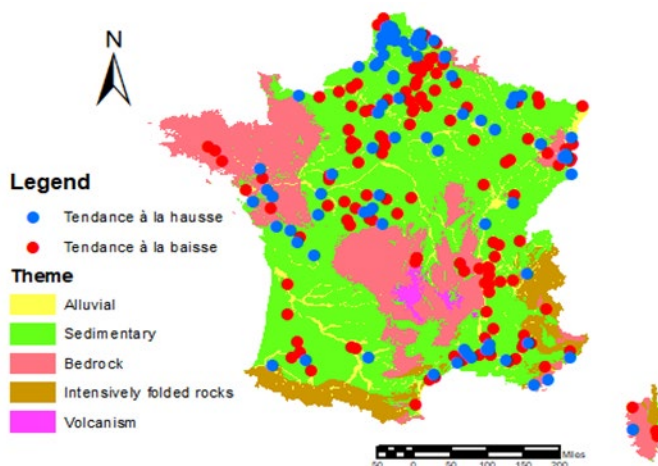
Example of displaying point information on raster maps

3) Schematics showing time variant recharge values and uncertainty analysis over selected period



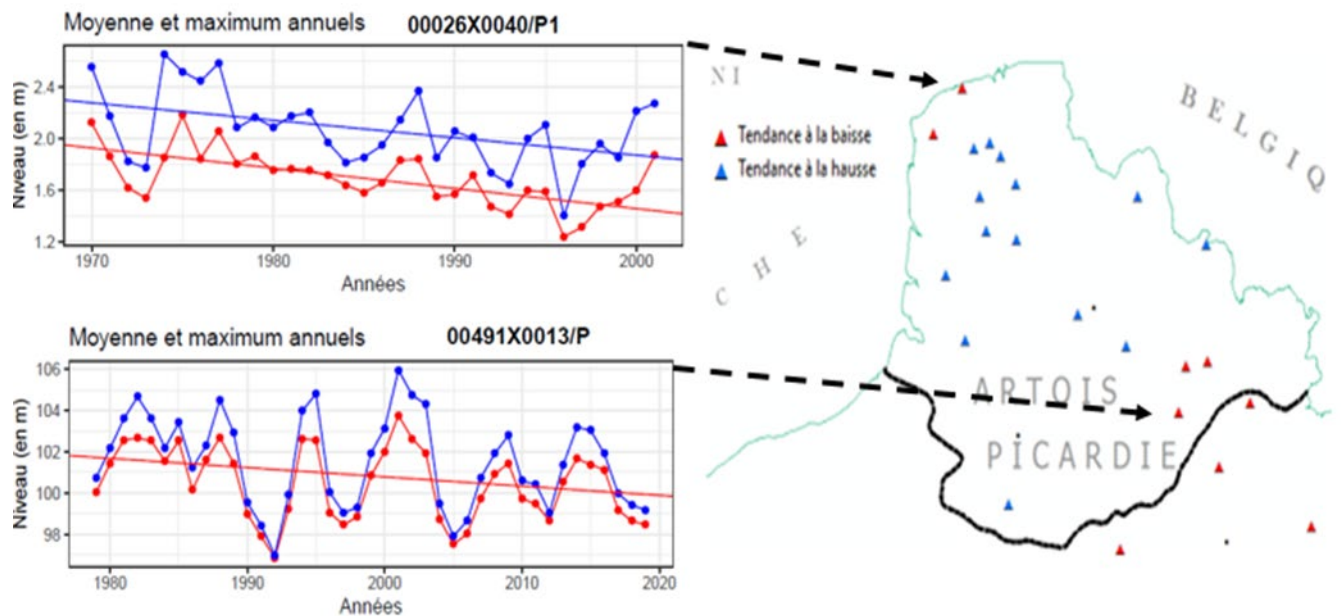
Example of Fig. Time variant plots with bounds of uncertainty analysis

4) Point statistical information



Example of displaying point statistical information on raster maps

5) Schematics showing groundwater level values and trends over selected period



Example of Fig. plots of groundwater level plots with trends

5.3.2 Requirements:

Product title	Nr	Requirement	Description
N°5-Pan European net-precipitation map (T4.6, D4.4)	1	Search based on location	This search is intended to work either by entering an address or geographical coordinates. Zoom/pan to the location will occur when pressing enter
	7	Web page with all services	A viewer where each project can see all the web map services that the project decides to show. It consists of a webpage with a list of all services comprised in the platform, including both the services directly available from EGDI platform and those drawn from the thematic projects
	9	Download data (no access control)	Open access to a documents/data repository. Raster included in this product will be in EGDI repository and we should allow all users to download them?
	12	Overview panel	A window that allows the user to locate the position of the viewer window within a larger zoom (e.g., within a political map of Europe).
	14	Export map	It allows users to export the map (comprising objects and layers) displayed in the viewer as images
	18	Transparency	It allows users to adapt the percentage of transparency of a layer
	17	Multiscaling	Functionality that interactively adapts the resolution of the map, objects' sizes and the layers displayed in the viewer when the user zooms in and out. Layers and/or objects should therefore contain information on the suitable scale from which they should start appearing/disappearing in the viewer.



Product title	Nr	Requirement	Description
N°6-Recharge values at selected locations	1	Search based on location	This search is intended to work either by entering an address or geographical coordinates. Zoom/pan to the location will occur when pressing enter
	7	Web page with all services	A viewer that can be easily reused and where each project can see all the web map services that the project decides to show. It consists in a web-page showing all the data/services accessible/downloadable (including the 3D models) classified by projects/themes. Projects need to provide the files and metadata to describe the content and find it back using the catalogue.
	14	Export map	It allows users to export the map (comprising objects and layers) displayed in the viewer as images.
	17	Multiscaling	Multiscaling; showing more and more details when user zoom in to an area

Product title	Nr	Requirement	Description
N°7-Schematics showing time variant recharge values and uncertainty analysis over selected period (Static)	1	Search based on location	This search is intended to work either by entering an address or geographical coordinates. Zoom/pan to the location will occur when pressing enter
	7	Web page with all services	A viewer that can be easily reused and where each project can see all the web map services that the project decides to show. It consists in a web-page showing all the data/services accessible/downloadable (including the 3D models) classified by projects/themes. Projects need to provide the files and metadata to describe the content and find it back using the catalogue.
	14	Export map	Allows users to export the composition displayed in the viewer to PDF or JPG file
	9	Download data (no access control)	Open access to a document/data repository.
	10	Identify+follow link	After a getfeatureinfo request, a pop-up window appears with a link to access the requested documents or URL. The files must be stored in the data repository and metadata database. The documents must be stored in EGDI repository.

Product title	Nr	Requirement	Description
N°8-Map displaying aquifer vulnerability to climate change (D4.2)	1	Search based on location	This search is intended to work either by entering an address or geographical coordinates. Zoom/pan to the location will occur when pressing enter
	7	Web page with all services	A viewer where each project can see all the web map services that the project decides to show. It consists of a webpage with a list of all services comprised in the platform, including both the services directly available from EGDI platform and those drawn from the thematic projects
	12	Overview panel	A window that allows the user to locate the position of the viewer window within a larger zoom (e.g., within a political map of Europe).
	18	Transparency	It allows users to adapt the percentage of transparency of a layer



Product title	Nr	Requirement	Description
N°9-Schematics showing time variant recharge values and uncertainty analysis over selected period (Dynamic)	1	Search based on location	This search is intended to work either by entering an address or geographical coordinates. Zoom/pan to the location will occur when pressing enter
	7	Web page with all services	A viewer that can be easily reused and where each project can see all the web map services that the project decides to show. It consists in a web-page showing all the data/services accessible/downloadable (including the 3D models) classified by projects/themes. Projects need to provide the files and metadata to describe the content and find it back using the catalogue.
	14	Export map	Allows users to export the composition displayed in the viewer to PDF or JPG file
	16	Display a graph with time series data (piezo levels, rain....)	Display a graph with time series data
	17	Multiscaling	Multiscaling; showing more and more details when user zoom in to an area

Product title	Nr	Requirement	Description
N°10-Statistical values calculated at selected points	1	Search based on location	This search is intended to work either by entering an address or geographical coordinates. Zoom/pan to the location will occur when pressing enter
	7	Web page with all services	A viewer that can be easily reused and where each project can see all the web map services that the project decides to show. It consists in a web-page showing all the data/services accessible/downloadable (including the 3D models) classified by projects/themes. Projects need to provide the files and metadata to describe the content and find it back using the catalogue.
	14	Export map	It allows users to export the map (comprising objects and layers) displayed in the viewer as images.
	17	Multiscaling	Multiscaling; showing more and more details when user zoom in to an area



Product title	Nr	Requirement	Description
N°11-Schematics showing groundwater level values and trend over selected period (static)	1	Search based on location	This search is intended to work either by entering an address or geographical coordinates. Zoom/pan to the location will occur when pressing enter
	7	Web page with all services	A viewer that can be easily reused and where each project can see all the web map services that the project decides to show. It consists in a web-page showing all the data/services accessible/downloadable (including the 3D models) classified by projects/themes. Projects need to provide the files and metadata to describe the content and find it back using the catalogue.
	14	Export map	Allows users to export the composition displayed in the viewer to PDF or JPG file
	9	Download data (no access control)	Open access to a document/data repository.
	10	Identify+follow link	After a getfeatureinfo request, a pop-up window appears with a link to access the requested documents or URL. The files must be stored in the data repository and metadata database. The documents must be stored in EGDI repository.



6 DATA FOR EGDI FROM WP5

6.1 Description of the products

Title and description		Nº12-Geological 3D model from Emilia Romana	Nº13-Pilots description and assessment report for sea/salt water intrusion	Nº14-Journal papers	Nº15-Report from all the WP5 tasks (Technical note of the method to assess seawater intrusion & Guideline for WP5)
Product Type	Structured Data (Vector, raster etc.)	X (vector, raster, table)	X (vector)		
	Unstructured data	X (report)	X (PDF)	X (PDF-autor copy)	X (PDF)
Data sources		Emilia-Romagna Region Databases	Partners and 3 rd parties contributions to the WP	IGME and other partners and 3 rd parties contributions to the WP	IGME and other partners and 3 rd parties contributions to the WP
Spatial dimension		XYZ points, 3D polylines, 3D polygons, 3D meshes (volumes)	Polygons		
Temporal dimension	static	X	X		
	dynamic: real time (yes/no)				
Scale		1:50000/1:10000	1:50000/1:10000		
Coverage		Local (Pilot area)	Pilot area		
Projection system.		EPSG 5659	EPSG 4326		
Delivery Format to EGDI	OGC web services (WMS, WFS, WCS, etc.)	For 2D data: WMS, WFS, CSW			
	Uploading GIS files (ESRI shapfiles or GeoPackage.)	ESRI shapefile	ESRI Shapefile		
	Unstructured data (PDF, JPG; TXT, etc.)	PDF	PDF	PDF	PDF
Metadata:	Metadata provider (IGME, GBA etc.)	For 2Ddata: CSW http://geoportale.regione.emilia-romagna.it/rer_csw/	All partners in WP5	IGME and other partners and 3 rd parties contributions to the WP	All partners in WP5
	Metadata collection (Harvesting/direct editing)	harvesting	Direct editing	Direct editing	Direct editing



6.1 Description of attributes for each product

6.1.1 N°12-Geological 3D model from Emilia Romana

Layer: Meshes (volumes)

Name of the attribute	Description	Unit	Data type
GM	3D Geological model of Holocene succession within the pilot area	Resolution 100 m	meshes
GM_SBT	3D model of Soil Behaviour Type	Resolution 200 m	meshes
GM_k	3D model of hydraulic conductivity	Resolution 200 m	meshes
Salt water volume	part of the volume of the aquifer occupied by salt water	Resolution:200 m	mesh

Layer: Surfaces

Name of the attribute	Description	Unit	Data type
Digital Terrain Model	DTM of the coastal sector	Resolution 20 m	grid
Geological map	Geological map at 1:50000 from CARG project	Scale: 1:50000	Polygons, polylines
Piezometric surfaces	Surfaces of the higher and lower level of water table of the aquifer	Res. 200 m	grid
Fresh/salt water interface	Average depth of the f/s water interface	Res. 200 m	grid

Layer: tables

Name of the attribute	Description	Unit	Data type
CPT data	Cone penetration test data visualized as 3D columns	2 cm	XYZ points and tables
CPT data elaboration	Parameters derived from CPT data as Soil Behaviour Type and Hydraulic Conductivity; visualized as 3D columns	2 cm	XYZ points and tables

6.1.2 N°13-Pilots description and assessment report for sea/salt water intrusion

Name of the attribute	Description	Unit	Data type
Pilot name	The name of the pilot		text
Pilot number	Number of the pilot (from the proposal)		number
Country	Country where the pilot is		text
Area	Area of pilot in Km ²	Km ²	number
Precipitation	Mean precipitation in the pilot	mm	number
Groundwater recharge	Mean annual recharge in the pilot	mm	number
GSO responsible	Responsible GSO		text
EU region	Region where the pilot is (defined following the classification proposed in Figure 6.1)		text
Aquifer geology	Main geology of the aquifers (according to Figure 6.2). You can use titles (for instance Sand and Gravels) for a group or use detailed names descriptions (for instance Glacial sand and gravel deposits).		text



Name of the attribute	Description	Unit	Data type
Aquifer type	Type of aquifer (according to the following three values of the codified list of INSPIRE “AquiferMediaTypeValue”): “Porous”, “Fissured”, or “Porous and fissured”		text
Primary water use	Primary water use: Drinking, irrigation, industry. Hydropower is included in industry. Use one or a combination of them)		text
Method to assess seawater intrusion	Methodology to assess seawater intrusion (GIS-MaRT; other)		text

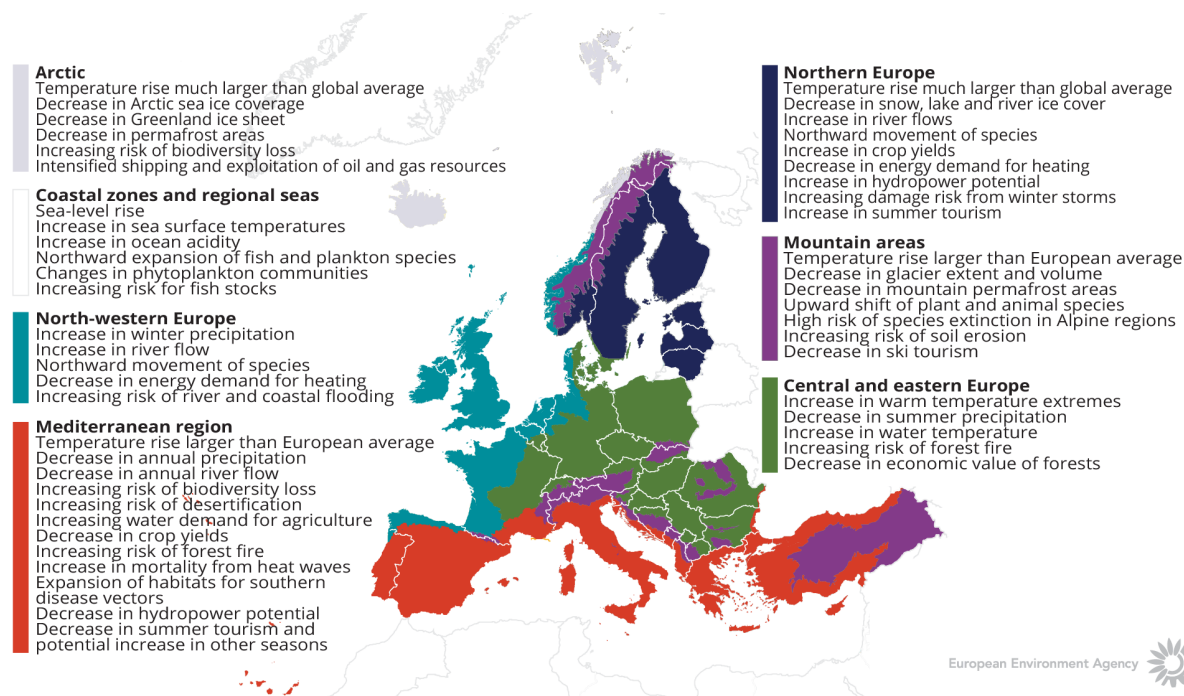


Figure 6. 1 EU regions

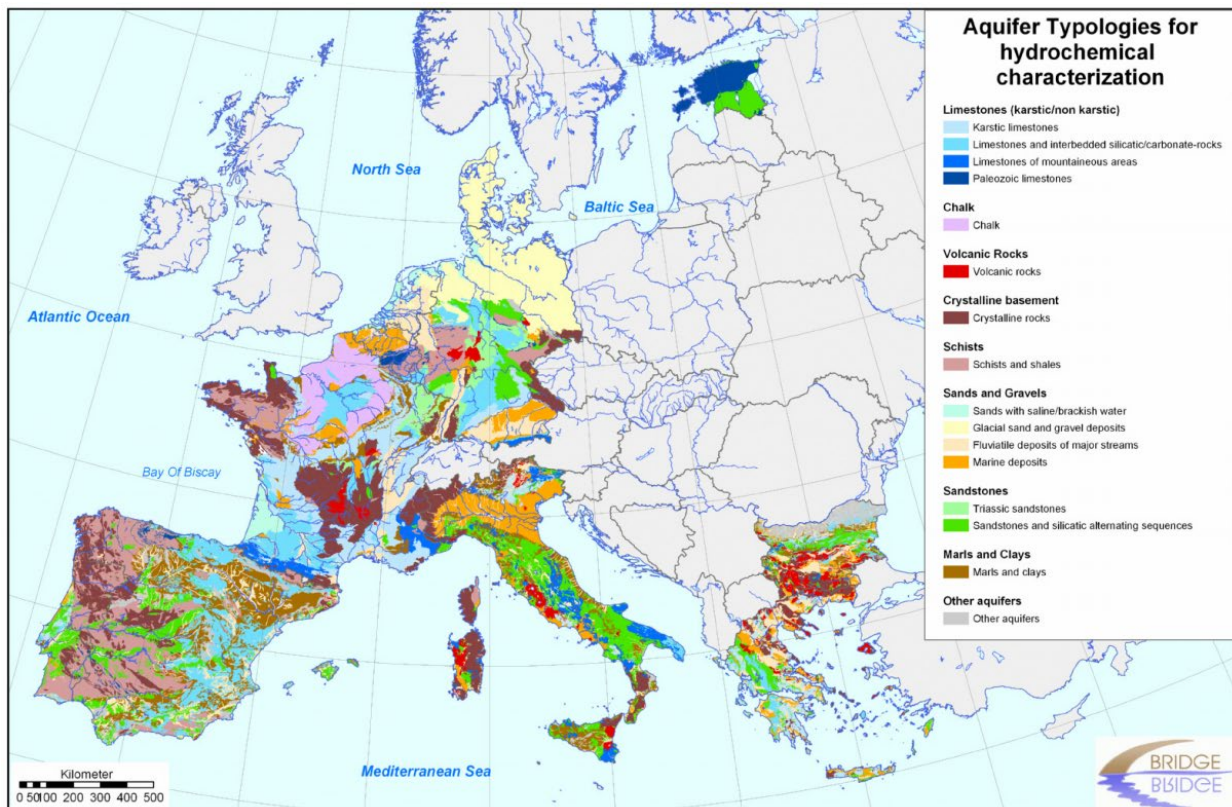


Figure 6. 2 Aquifer typologies

6.2 Use case and requirements associated to each product

6.2.1 Use case

6.2.1.1 N°12-Geological 3D model from Emilia-Romagna

A detail 3D model at regional/local scale to visualize the geometry and lithological characteristic of the coastal aquifer. The model shows some parameters of soils as *Soil Behavior type* and hydraulic conductivity in order to point out peculiarities and heterogeneities within the aquifer. The saturated volume and its part occupied by salt water can be visualized.

6.2.1.2 N°13-Pilots description and assessment report for sea/salt water intrusion

The user can visualize the pilot description and the application of a method to assess seawater intrusion in that pilot. This product would be a map (shape) and the PDFs will be attached to each pilot.

6.2.1.3 N°14-Journal papers

The author copy and DOI url would be facilitated.

6.2.1.4 N°15-Report from all the WP5 tasks Technical note of the method to assess seawater intrusion & Guideline for WP5

A user accesses the search system and types "sea water". In the results window you will see a list of the different reports of our WP5.

The result of the search does not have to be by exact coincidence, it would be advisable to look for synonyms and related terms.

For example, the search should give the same results if you search for sea water, sea-water and seawater.



6.2.2 Requirements:

Product title	Nr	Requirement	Description
Nº12-Geological 3D model from Emilia-Romagna	30	Handling and displaying 3D models	This tool should allows users to visualized, query and cut the models
	34	Virtual cross section	
Nº13-Pilots description and assessment report for sea/salt water intrusion	1	Search based on location	This search is intended to work either by entering a city or country name or geographical coordinates. Zoom to the location will occur when pressing enter.
	2	Search documents	Allow end users to find the pilot description for each pilot in WP5
	9	Download data (no access control)	Open access to a documents/data repository.
	13	Legend with tree view / hierarchical on/off switching	It will be possible to display different fields e.g. EU region aquifer geology, aquifer type, primary water use, method to assess seawater intrusion... Those will be individually visualized.
	14	Export map	Export composition displayed in the viewer to PDF or JPG file; scale and arrow indicating north should be included, option to choose also a georeferenced image for download.
Nº14-Report from all the WP5 tasks Technical note of the method to assess seawater intrusion & Guideline for WP5	2	Search documents	Allow end users to find all the reports produced our WP5 by key words, authors our abstract included in the several PDF
	9	Download data (no access control)	Open access to a document/data repository
Nº15-Journal paper	2	Search documents	Allow end users to find the journal paper by key words, authors our abstract included in the PDF
	9	Download data (no access control)	Open access to the author copy and DOI url



7 DATA FOR EGDI FROM WP6

7.1 Description of the products

Title and description		Nº16-Pilots description and assessment report for adaptation	Nº17-Journal paper	Nº18-Report from all the WP6 tasks (Development of climate change projections and adaptation scenarios & Guideline for WP6)
Product Type	Structured Data (Vector, raster etc.)	X (vector)		
	Unstructured data	X	X	X
Data sources		Partners and 3 rd parties contributions to the WP	IGME	IGME and other partners and 3 rd parties contributions to the WP
Spatial dimension		Polygons		
Temporal dimension	static	X		
	dynamic: real time (yes/no)			
Scale		Vary (1:50.000 – 1:1.000.000)		
Coverage		Pilot area		
Projection system.		EPSG 4326		
Delivery Format to EGDI	OGC web services (WMS, WFS, WCS, etc.)			
	Uploading GIS files (ESRI shapfiles or GeoPackage.)	ESRI Shapefile		
	Unstructured data (PDF, JPG; TXT, etc.)	PDF	PDF-author copy	PDF
Metadata:	Metadata provider (IGME, GBA etc .)	All partners in WP5	IGME	All partners in WP5
	Metadata collection (Harvesting/direct editing)	Direct editing	Direct editing	Direct editing



7.2 Description of attributes for each product

7.2.1 N°16-Pilots description and assessment report for adaptation

Name of the attribute	Description	Unit	Data type
Pilot name	The name of the pilot		text
Pilot number	Number of the pilot (from the proposal)	addimensional	number
Country	Country where the pilot is		text
Area	Area of pilot in Km ²	Km ²	number
Precipitation	Mean precipitation in the pilot	mm	number
Groundwater recharge	Mean annual recharge in the pilot	mm	number
GSO responsible	Responsible GSO		text
EU region	Region where the pilot is		text
Topic	The topic of the WP (integrated assessment of groundwater-surface water; groundwater recharge and vulnerability; seawater intrusion)		text
Major challenge	The major challenge in the pilot (intrusion, droughts, floods, dependent ecosystem, shallow groundwater)		text
Type of adaptation strategies	Based on the offer; based on the demand; mixed		text
Primary water use	Primary water use (one use or a combination of them):		text

7.3 Use case and requirements associated to each product

7.3.1 Use case.

7.3.1.1 N°16-Pilots description and assessment report for adaptation

The user can visualize the pilot description and the adaptation strategies applied in that pilot. This product would be a map (shape) and the PDFs will be attached to each pilot.

7.3.1.2 N°17-Journal paper

The author copy and DOI url would be facilitated.

7.3.1.3 N°18-Report from all the WP6 tasks (Development of climate change projections and adaptation scenarios & Guideline for WP6)

A user accesses the search system and types "adaptation strategies". In the results window you will see a list of the different reports of our WP6.

The result of the search does not have to be by exact coincidence, it would be advisable to look for synonyms and related terms.

For example, the search should give the same results if you search for adaptation measures.



7.3.2 Requirements

Product title	Nr	Requirement	Description
Nº16-Pilots description and assessment report for adaptation	1	Search based on location	This search is intended to work either by entering a country name or geographical coordinates. Zoom to the location will occur when pressing enter.
	2	Search documents	Allow end users to find the pilot description for each pilot in WP6.
	9	Download data (no access control)	Open access to a documents/data repository.
	13	Legend with tree view / hierarchical on/off switching	It will be possible to display different fields e.g. type of adaptation strategy (based on the offer or based on the demand) or according to the WP which is related to (recharge, seawater intrusion...). Those will be individually visualized.
	14	Export map	Export composition displayed in the viewer to PDF or JPG file; scale and arrow indicating north should be included, option to choose also a georeferenced image for download.
Nº17-Report from all the WP6 tasks: Development of climate change projections and adaptation scenarios & Guideline for WP6	2	Search documents	Allow end users to find all the reports produced our WP6 by key words, authors our abstract included in the several PDF.
	9	Download data (no access control)	Open access to a document/data repository.
Nº18-Journal paper	2	Search documents	Allow end users to find the journal paper by key words, authors our abstract included in the PDF.
	9	Download data (no access control)	Open access to the author copy and DOI url.



8 APPENDIX I – OGC WEB SERVICES IDENTIFY BY WP3 GIP-P PROJECT(INFORMATION EXTRACTED FROM GIP-P-D3.1DATA MODELS, STANDARD GUIDELINES AND TOOLKITS “)

Open Geospatial Consortium (OGC) web services offer a cost efficient and open source technology that permits transfer of standardized data from distributed sources, removing the need for data to be regularly uploaded to a centralized database. When combined with community defined exchange standards or schemas, OGC services offer the ability to access the latest data from source agencies in a consistent format.” (O Raymond, B Simmons, E Boisvert, 2010. Information Models for the Australian Geoscience Community: GeoSciML, EarthResourceML and GroundWaterML)

1. SPARQL Endpoint

“SPARQL is an RDF query language—that is, a semantic query language for databases—able to retrieve and manipulate data stored in Resource Description Framework (RDF) format. It was made a standard by the RDF Data Access Working Group (DAWG) of the World Wide Web Consortium, and is recognized as one of the key technologies of the semantic web. On 15 January 2008, SPARQL 1.0 became an official W3C Recommendation, and SPARQL 1.1 in March, 2013.” (<https://en.wikipedia.org/wiki/SPARQL>)

“A SPARQL Endpoint is a Point of Presence on an HTTP network that’s capable of receiving and processing SPARQL Protocol requests. It is identified by a URL commonly referred to as a SPARQL Endpoint URL.” (<https://medium.com/virtuoso-blog/what-is-a-sparql-endpoint-and-why-is-it-important-b3c9e6a20a8b>)

A SPARQL endpoint could be implemented for all GeoERA projects/applications.

2. 1.1.3.2 X3D

X3D is an ISO-ratified, royalty-free open standards file format and run-time architecture to represent and communicate 3D scenes and objects. X3D has evolved from its beginnings as the Virtual Reality Modeling Language (VRML) to the considerably more mature and refined ISO X3D standard. X3D provides a system for the storage, retrieval and playback of real time 3D scenes in multiple applications, all within an open architecture to support a wide array of domains and user scenarios.

As an open standard X3D can run on many platforms, but importantly can render 3D models in most web browsers without the requirement for additional or proprietary applications. Further, once models are developed utilizing X3D, these easily port to alternative platforms like holographic, head-mounted or other display devices.

(<http://www.web3d.org/x3d/what-x3d>)

3. Catalogue Service (Catalogue Service for the Web – CSW)

“Catalogue services support the ability to publish and search collections of descriptive information (metadata) for data, services, and related information objects. Metadata in catalogues represent resource characteristics that can be queried and presented for evaluation and further processing by both humans and software. Catalogue services are required to support the discovery and binding to registered information resources within an information community.



OGC Catalogue interface standards specify the interfaces, bindings, and a framework for defining application profiles required to publish and access digital catalogues of metadata for geospatial data, services, and related resource information. Metadata act as generalized properties that can be queried and returned through catalogue services for resource evaluation and, in many cases, invocation or retrieval of the referenced resource. Catalogue services support the use of one of several identified query languages to find and return results using well-known content models (metadata schemas) and encodings.”

Full documentation available at: <https://www.opengeospatial.org/standards/cat>

4. Sensor Observation Service (SOS)

“The SOS standard is applicable to use cases in which sensor data needs to be managed in an interoperable way. This standard defines a Web service interface which allows querying observations, sensor metadata, as well as representations of observed features. Further, this standard defines means to register new sensors and to remove existing ones. Also, it defines operations to insert new sensor observations. This standard defines this functionality in a binding independent way; two bindings are specified in this document: a KVP binding and a SOAP binding.”

Full documentation available at: <https://www.opengeospatial.org/standards/sos>

5. SensorThings API

“The OGC SensorThings API provides an open, geospatial-enabled and unified way to interconnect the Internet of Things (IoT) devices, data, and applications over the Web. At a high level the OGC SensorThings API provides two main functionalities and each function is handled by a part. The two parts are the Sensing part and the Tasking part. The Sensing part provides a standard way to manage and retrieve observations and metadata from heterogeneous IoT sensor systems. The Tasking part is planned as a future work activity and will be defined in a separate document as the Part II of the SensorThings API.”

It is built on O&M and, as summarized in D5.2 section “1.3 Observation features OGC services strategy”, is often wrongly reduced to the REST binding of SOS 2.0.

Full documentation available at: <https://www.opengeospatial.org/standards/sensorthings>

6. Web Feature Service (WFS)

The Web Feature Service (WFS) represents a change in the way geographic information is created, modified and exchanged on the Internet. Rather than sharing geographic information at the file level using File Transfer Protocol (FTP), for example, the WFS offers direct fine-grained access to geographic information at the feature and feature property level.

This International Standard specifies discovery operations, query operations, locking operations, transaction operations and operations to manage stored, parameterized query expressions.

Discovery operations allow the service to be interrogated to determine its capabilities and to retrieve the application schema that defines the feature types that the service offers.

Query operations allow features or values of feature properties to be retrieved from the underlying data store based upon constraints, defined by the client, on feature properties.



Locking operations allow exclusive access to features for the purpose of modifying or deleting features.

Transaction operations allow features to be created, changed, replaced and deleted from the underlying data store.

Stored query operations allow clients to create, drop, list and described parameterized query expressions that are stored by the server and can be repeatedly invoked using different parameter values.

This International Standard defines eleven operations:

- GetCapabilities (discovery operation)
- DescribeFeatureType (discovery operation)
- GetPropertyValue (query operation)
- GetFeature (query operation)
- GetFeatureWithLock (query & locking operation)
- LockFeature (locking operation)
- Transaction (transaction operation)
- CreateStoredQuery (stored query operation)
- DropStoredQuery (stored query operation)
- ListStoredQueries (stored query operation)
- DescribeStoredQueries (stored query operation)

In the taxonomy of services defined in ISO 19119, the WFS is primarily a feature access service but also includes elements of a feature type service, a coordinate conversion/transformation service and geographic format conversion service.

Full documentation available at: <https://www.opengeospatial.org/standards/wfs>

7. Web Map Service (WMS)

The OpenGIS® Web Map Service Interface Standard (WMS) provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, Vector tiles, etc) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent so that layers from multiple servers can be combined or not.

Full documentation available at: <https://www.opengeospatial.org/standards/wms>

8. Web Map Tile Service (WMTS)

A WMTS enabled server application can serve map tiles of spatially referenced data using tile images with predefined content, extent, and resolution.

Full documentation available at: <https://www.opengeospatial.org/standards/wmts>

9. Web Coverage Processing Service (WCPS)

“The OGC® Web Coverage Processing Service (WCPS) defines a protocol-independent language for the extraction, processing, and analysis of multi-dimensional coverages representing sensor, image, or statistics data.”



Full documentation available at: <https://www.opengeospatial.org/standards/wcps>

10. Web Coverage Service (WCS)

“A Web Coverage Service (WCS) offers multi-dimensional coverage data for access over the Internet. WCS Core specifies a core set of requirements that a WCS implementation must fulfill. More information on spatio temporal coverage / datacube standards can be found at <http://myogc.org/go/coveragesDWG>, including tutorials and webinars, conformance testing, background information, and updates on standardization progress.”

Full documentation available at: <https://www.opengeospatial.org/standards/wcs>



9 APPENDIX II – MATRIX OF REQUIREMENTS DERIVED FROM GIP-P D2.2.1

These are the project-specific requirements.

Additional basic requirements are described in chapter 2 of deliverable D2.2.1 (page 7)

All requirements were derived from deliverable D2.2.1

This document is intended to give insight in the various requirements that were harvested from the projects and as the basis for decisions about prioritization towards development of requested functionalities.

A more detailed description for each requirement is available in the "Description" field.

Potential questions for clarification of the requirements are written in the "Questions" column

The requirements currently earmarked as "High Priority" are colored **bright green** in the Number column (Column 1) requirements marked with **bright red** in column 1 is too complex and time consuming for GeoERA.

Red letters: functionalities/questions that need special attention from projects.

Colour codes in column two and four of the table indicate:

Green = 2D functionality

Blue = 2.5D functionality

Red = 3D functionality

No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGDl"	Description	Questions & comments	Other comments derived from D2.3.1
1	Search based on location	Go to location by typing city or coordinates in the search field	This search is intended to work either by entering an address, city or geographical coordinates. Zoom to the location will occur when pressing enter.	EGDI uses Lat/Long in decimal degrees (WGS84) for coordinate searches. Is that compatible with your project?	
2	Search Documents (require a doc repository)	Search through metadata, datasets and documents directly from the EGDl portal + Search through documents + Ranking of search results based on relevance + Interface to upload documents and metadata to a document repository + Interface to MICKA	Allow users to search documents like in Minerals4EU, where metadata and indexed documents can be found by users (documents can even be georeferenced)	1. Do you have resources to achieve this metadata task? 2. Will the metadata and/or documents be harvested from other knowledge bases (e.g., KINDRA/EIGR, HIKE, etc.) or databases? Or, do the project require that the documents and metadata are stored in MICKA	To make searching better, layers defined in the EGDl portal must also be stored in MICKA. Searching documents directly from EGDl requires a document handling system, which is a complex thing to do. However, it can be created if projects required so.



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
				database? 3. Will the project provide georeferenced documents to be archived/visualized in EGD? 4. Should the documents be findable directly from EGD or only through MiCA?	
3	Searching for maps	Searching for maps	With time, many thematic maps will be defined by every project. It should thus be possible to search among the maps. When a map is selected from the search tool, the map will open with a selection of predefined active layers and with a predefined zoom level.		
4	Interface to upload and thematize GeoPackages	Enhanced interface to upload and thematize Shapefiles and GeoPackages	Shapefile uploader in EGD 1.1 must be extended by allowing the upload of GeoPackages with tools to thematize the layers and add metadata.	Would you be delivering data in GeoPackage format?	Data delivered in GeoPackage format (supported by ArcGIS, QGIS and others) may be accepted by EGD. However, <u>ArcGIS Geodatabase file format (*.gdb or *.mdb) will not be accepted.</u> Meaning that all projects producing data with ArcGIS should provide them to EGD either as GeoPackages or as individual shapefiles.
5	Enhanced interface to upload and thematize Shapefiles		Shapefile uploader in EGD 1.1 will be extended with tools to thematize the layers and add metadata.		



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
6	Interface to knowledge base and related documents	Interface to knowledge base (existing from HIKE)	Like No.2, but documents are stored in the knowledge base that is to be developed in the framework of the HIKE project	Are there other knowledge-based systems, apart from Kindra/EIGR (see No 25) and that to be created by HIKE, to which the GIP should create interfaces?	<u>The feasibility of this functionality has not been evaluated yet due to a lack of details on the architecture, etc. of the HIKE knowledge base.</u> If it has not been done yet, HIKE and GIP WP6 must contact each other to solve this issue.
7	Web page with all services	Web page with a list of all services comprised in the platform, including both the services directly available from EGD platform and those drawn from the thematic projects	A viewer where each project can see all the web map services that the project decides to show. It consists of a webpage with a list of all services comprised in the platform, including both the services directly available from EGD platform and those drawn from the thematic projects		



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGDl"	Description	Questions & comments	Other comments derived from D2.3.1
8	Download data+access control	Download of data with or without access control	The access control is intended to restrict the access to certain documents and data repositories (e.g., those under embargo) to only certain people (e.g., partners and stakeholders).	Information to provide when sending the data to EGDl concerning this functionality: 1. Specify which data should be downloadable and which should not. Do not forget to mention all the information that should be included in the downloadable data files. 2. In what format would you like the data/documents to be downloaded? 4. Do you want the download to be possible for all users? Otherwise, please, make sure that the data that will require access control are clearly highlighted when you provide them to EGDl. 6. For the downloadable data, please, specify if the access to certain datasets should be partially restricted or fully available. 8. If the data are spatial, do they have to be downloaded in the same projections that they are shown? If not, please specify the projection system (EPSG). 10. If you are requiring access control for some datasets, please, state the reason (e.g., embargo, etc.).	
9	Download data (no access control)		Open access to a document/data repository.		



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGDI"	Description	Questions & comments	Other comments derived from D2.3.1
10	Identify+follow link	Not comprised in D2.3.1, as it already exists in EDGI	After a getfeatureinfo request, a pop-up window appears with a link to access the requested documents or URL. The files must be stored in the data repository and metadata database. The documents must be stored in EDGI repository.		This functionality already exists in EDGI
11	Specific projection	Display data in different projections + Projections	EDGI official projections for visualization are EPSG 3034 Lambert Conformal Conic projection.	1. Do you require the use of another projection for visualization purposes? If so, could you specify which one and why? 2. If the project is providing data as webservices (WMS, etc.); would it be a problem to provide them in EPSG:3034? 3. If possible, specify the projection system (EPSG) in which you would like to deliver the various data the project will generate.	GIP-P does not recommend the use of several projections for visualization. In principle, all data will be visualized in EDGI by using EPSG:3034. It is however possible to perform calculations in other projections (e.g., EPSG:3035) by transforming them into EPSG:3034. Projects can provide data in whichever projection they want as long as its conversion to EPSG:3034 is straight forward. However, Web services must be delivered to the EDGI platform in EPSG:3034. Otherwise, EDGI and web services from all projects would have to support all the required projections. If projects require other projections for visualization, please, send us an email specifying which projection you need and why the use of EPSG:3034 for visualization purposes is not convenient for your project.



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGDI"	Description	Questions & comments	Other comments derived from D2.3.1
12	Overview panel	Small overview map	A window that allows the user to locate the position of the viewer window within a larger zoom (e.g., within a political map of Europe).		A basic version of this functionality already exists in EDGI
13	Legend with tree view / hierarchical on/off switching	Legend with hierarchy/tree view + Switching layers on / off	Panel to see and choose the available layers and services that can be displayed in the viewer, including switching on/off layers classified in hierarchical groups.		
14	Export map	Export current view as a high-resolution image for publication.	It allows users to export the map (comprising objects and layers) displayed in the viewer as images.	1. Is there a specific format you would like the maps to be exported in (PDF, JPG, PNG...)? 2. Specify, if any, which auxiliary elements do you want to appear in the output format (graphical/numerical scale, arrow indicating north, etc.). 3. Should the images be georeferenced? 4. Specify the size (A4, A3...) 5. Can you provide a template?	
15	Handling time component	Handling of time component	Functionality for displaying/interacting with time series datasets and to display grids and layers that change over time.	1. What interaction is needed with the data? 2. Could you provide an example?	



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
16	Display a graph with time series data (piezo levels, rain....)	Display a graph with time series data	Functionality to display a graph showing the evolution of time series. It either displays an existent graph after a getfeatureinfo or it builds the graph based on data extracted from tables/attributes associated with the layers displayed.	Specify what types of graphs are required. Could you provide an example or template? Information to provide when sending the data to EGD concerning this functionality: 1. If the graphs are generated "on the fly" from EGD, please, specify to which objects, layers, etc. and data (tables, attributes, etc.) they should be generated from. 2. If the graphs are harvested from data archived in a database or document repository, please, specify to which objects, layers, etc. they should be linked and from where EGD should harvest them.	If necessary, it is possible to include links to external services that deliver time series.
17	Multiscaling	Multiscaling; showing more and more details when user zoom in to an area	Functionality that interactively adapts the resolution of the map, objects' sizes and the layers displayed in the viewer when the user zooms in and out. Layers and/or objects should therefore contain information on the suitable scale from which they should start appearing/disappearing in the viewer.	Information to provide when sending the data to EGD concerning this functionality: 1. Please, provide scale range within which each layer should be displayed. 2. Is clustering desirable?	
18	Transparency	Transparency of layers	It allows users to adapt the percentage of transparency of a layer		



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
19	Display (virtual) logs	Displaying virtual logs through models	it either displays a previously defined log or it builds one based on the layer/s displayed. The location is defined by the user with a getfeatureinfo request.	1. Specify what type of logs (format, etc.) should be generated/displayed? 2. Specify the format the project will use to deliver the logs and the format the project expects EGD to display them. 3. When sending the data to EGD, please, specify the layers that should be used to generate virtual logs, as well as the datasets, tables or attributes from where the data should be retrieved. 4. Is there a template that EGD should follow? Could you provide an example? 5. If the logs are to be displayed as documents/images (hyper)link to georeferenced objects/layers, please, specify to which elements the logs should be linked and from where EGD should harvest them.	
20	Create virtual logs from table data or 2.5d layers		Similar to No. 19, although it creates the log from a database or a 2.5D layer		
21	Display (virtual) cross sections	Display virtual cross sections	It either displays cross sections previously constrained or it builds one based on the layer/s displayed. The location is defined by the user with a getfeatureinfo request or by drawing a trace on the map.	1. Specify in which format the project will provide the cross-section documents and in which format they should be displayed. 2. if you want EGD to create the cross-section "on the fly", please, specify, when providing the data to EGD, which	



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
22	Create virtual cross section 2.5d layers from a user defined geometry		Similar to No. 22, but the cross section is created from lines/polylines and/or curves drawn by the users.	tables, attributes, etc. should be used for that. 3. could you provide an example of the cross section you are expecting EGD to show? 4. If the cross-sections are to be displayed as documents/images (hyper)link to georeferenced objects/layers, please, specify from where EGD should harvest them. Specify also which element/s the cross-section will be linked to; e.g., one or several records of a database, an information layer, georeferenced object/s, etc.	
23	Creation of statistical diagrams, rose diagrams, histograms...	Creation of statistical diagram, rose diagrams, histograms...	Functionality to display a graph showing diagrams. It displays either an existent graph or it builds one based on table values associated with the selected layers/objects.	1. Do you expect EGD to calculate the diagrams or you will deliver prebuild diagrams? 2. If EGD must calculate the diagrams, then answer the following questions: i. Build based on which information? ii. Specify which type of statistical diagram should be displayed. iii. Specify database, fields and template of the statistical diagram. Please, provide examples. iv. Specify to which elements (e.g., to each record of a database, an	The feasibility of this functionality has not been evaluated yet. GIP needs more information on what the projects requiring it are expecting. Projects intending to use this functionality should provide examples/guidelines to GIP, clearly specifying how this functionality should work according to their needs. They can send them directly to GIP WP6 coordinator (cc: GIP WP2 coordinator). WP6/WP2 will organise a conf. call with the concerned projects if further information is needed.



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
				information layer) the diagram will be related.	
24	Metadata compatible with other EU inventories	Metadata compatible with other EU inventories	Enable harvesting from metadata catalogues other than EGD/MiCKA.	1. If Metadata is to be harvested from catalogues other than MiCKA, please, provide a template and information on the vocabularies and standards followed by those catalogues. 2. Harvesting data from external metadata repositories is possible, but the data provider must guarantee that the database will be properly maintained and regularly updated after the end of the project. Otherwise the metadata may become outdated after some time. Would the projects be able to guarantee this service?	Preferentially, metadata archived in other catalogues should have similar formats to those use by MiCKA and be compliant with the same international standards (INSPIRE).



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
25	Integration of KINDRA thesaurus	Integration of the KINDRA thesaurus	This functionality builds on and further develops the thesaurus and groundwater research classification of the European Inventory of Groundwater Research (KINDRA).	Projects utilizing KINDRA/EIGR thesaurus must decide together with EGD developers what is the most efficient way of doing its integration in EGD, who is going to participate in the governance workflow...	The feasibility of this functionality has not been evaluated yet. GIP needs more information on what the projects requiring it are expecting. Projects intending to use this functionality should provide examples/guidelines to GIP, clearly specifying how this functionality should work according to their needs. They can send them directly to GIP WP6 coordinator (cc: GIP WP2 coordinator). WP6/WP2 will organise a conf. call with the concerned projects if further information is needed.
26	Create simple queries and filters from the webGIS interface	Create simple queries and filters from the web GIS interface	It performs simple queries or filter on a layer of information. Both predefined queries and free queries require that the database is hosted in EGD infrastructure.	Information to provide when sending the data to EGD concerning this functionality: 1. Specify layers and fields to query 2. Do you need free or predefined queries? More than one condition?	
unsafe	27 SQL query directly to the database	SQL query directly to the database	Performs free queries on databases. This requires that databases are hosted in EGD infrastructure.	Information to provide when sending the data to EGD concerning this functionality: 1. Specify table and fields involved in the queries 2. More than one condition?	<u>Unsafe. It is not recommended opening the databases for users to execute SQL directly from the user interface. This can however be done when setting up the layers that query data stored in the EGD database.</u>



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGDI"	Description	Questions & comments	Other comments derived from D2.3.1
29	From getfeatureinfo creation of an automatic report querying a selection of layers	Not comprised in D2.3.1; this functionality already exists in EGDI	This functionality creates reports when clicking on a specific location of the map with the getfeatureinfo tool. These reports provide important values extracted from all layers that are switched on in the viewer and that contain information for that location. E.g., layers "topography" and "gravimetry" are switched on, when clicking in a location covered by both layers, a report will be generated, providing the elevation and the gravimetric measurement for that location.	When providing the data to EGDI, please, specify the layers to which this functionality will be applied and the attributes, tables, etc. from where the data included in the report will come from. Do you want EGDI to use a specific template for these reports? If so, please, send an example.	A basic version of this functionality already exists in EGDI
30	Handling and displaying 3D models	Handling and displaying 3D models + 3D model importers + 3D model exporters + Interface to upload 3D models and metadata	In the 2D viewer, the extent of the 3D model is displayed as a shape. By clicking on that shape, the user can access the 3D model. Note that EGDI might only handle one format for 3D data.	Please, specify the software used to generate 3D data and the formats in which the data will be provided to EGDI.	
31	Transparency of 3D	Transparency	It allows users to adapt the percentage of transparency.		
32	Quasi 4D viewer	Quasi 4D viewer	Quasi 4D viewers show the variation of the reality shown by 3D models based on different values of a given variable, which is different to the 3 spatial dimensions; e.g., time.	1. Could you provide an example for this functionality? 2. How (format, etc.) would Quasi 4D models be delivered to EGDI? 3. Would the 4D models be stored in EGDI? Or, should they be harvested from an external database?	The feasibility of this functionality has not been evaluated yet. GIP needs more information on what the projects requiring it are expecting. Projects intending to use this functionality should provide examples/guidelines to GIP, clearly specifying how this functionality should work according to their needs. They can send them directly to GIP WP6 coordinator (cc: GIP WP2 coordinator). WP6/WP2 will organise a conf. call with the concerned projects if further information is needed.



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
33	Virtual borehole	Display virtual logs	Like No. 19 and 20 but based on 3D data. It provides borehole information by using the getfeatureinfo.	Questions as in No.19 and 20.	
34	Virtual cross section	Create virtual cross section through models	Like No.21 and 22 but based on 3D data. It generates a cross section from a location selected with the getfeatureinfo or from a trace drawn by the user	Questions as in No. 21 and 22	
35	Virtual (horizontal) slice	Virtual (horizontal) slice	Like No. 35 but providing horizontal slices instead of vertical cross sections. For example, horizontal slices extracted from 3D seismic reflection data by selecting a range of values of two-way travel times.	Questions as in No. 21 and 22	
36	Handling uncertainty	Handling uncertainty	Descriptions for this functionality are not available yet. Defining the specifications for this is one of the outcomes of the 3DGEO-EU project.	Can you specify what type of data are to be expected (point clouds, voxels, points, reports) to show the uncertainty of models, etc.? Please, provide examples/templates.	3DGEO-EU must send guidelines to EGD! developers when they have more information on the way the uncertainty should be displayed.
37	Compass	Compass	Interactive compass rose indicating the orientation of the 3D model in the viewer		
38	Color / Alpha mapping functions to render attributes	Color / Alpha mapping functions to render attributes	color and transparency that is set based on attribute values. It allows the user to set the amount of transparency or the color that different areas will show based on values defined in the attributes of the selected layer.	Please, specify which attributes should be used for this. Could you provide an example?	



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
39	Glyphs for data representation	Glyphs for data representation	Visualization of data (points) as glyphs	1. Can you provide the glyphs that will be used? 2. Please, specify format for displaying them. 3. could you, please, send examples?	The feasibility of this functionality has not been evaluated yet. GIP needs more information on what the projects requiring it are expecting. Projects intending to use this functionality should provide examples/guidelines to GIP, clearly specifying how this functionality should work according to their needs. They can send them directly to GIP WP6 coordinator (cc: GIP WP2 coordinator). WP6/WP2 will organise a conf. call with the concerned projects if further information is needed.
40	Visualize of different models at same time	Visualize different models at same time	it displays different 3D models simultaneously in the same viewer	Can you provide an example of how you expect this functionality should work?	The feasibility of this functionality has not been evaluated yet. GIP needs more information on what the projects requiring it are expecting. Projects intending to use this functionality should provide examples/guidelines to GIP, clearly specifying how this functionality should work according to their needs. They can send them directly to GIP WP6 coordinator (cc: GIP WP2 coordinator). WP6/WP2 will organise a conf. call with the concerned projects if further information is needed.
too complex to be developed	41 Fly through (recordable)	Fly through (recordable)	It allows to navigate through the 3D model like flying an airplane. Possibility of recording the 'fly'.		



	No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGD"	Description	Questions & comments	Other comments derived from D2.3.1
within the scope of the GIP-P project.	42	Steering camera via geocoded locations	Steering camera via geocoded locations	Navigation of the camera position based on locations, such as addresses and geographical names. For example, the user types an address, this address is geocoded and the 'camera' position move to that geocoded position.		
	43	Predefined viewpoints	Predefined viewpoints	Navigation of the camera position and direction based on predefined locations.		
	44	Possibility to display objects	Possibility to display objects	This functionality allows the displaying of 3D objects, e.g., buildings.	Can you specify which 3D objects should be displayed?	The EGD 3D model database can store points, surfaces and closed volumes. <u>We need however to have examples of the objects the projects will generate and how they expect to have them visualized. Examples can be sent directly to GIP WP6 coordinator (cc: GIP WP2 coordinator).</u>
	45	Grid lines	Grid lines	It displays grid lines in order to get a feeling for scale in the 3D perspective.		
too complex to be developed within the scope of the GIP-P project.	46	API	API to extend the viewer	Advanced Programming Interface to all functionalities of the viewer, so that the viewer can be reused in the future (e.g., see Google Maps API)		



No	Functionalities (2D, 2.5D, 3D)	Equivalences with functionalities analysed in GIP-P D2.3.1 "Extensions to EGDI"	Description	Questions & comments	Other comments derived from D2.3.1
47	Exploded views of detailed part of 3D model	Exploded views of detailed part of 3D model (like the Polish viewer)	The inverse of an overview window (No.12): it provides details on part of the model while the user is navigating across it.	1. Should these detailed parts be predefined or user-changeable? 2. Could you provide an example?	Could you confirm that what it is written in the description of this functionality is what you expect from EGDI? The name of the functionality is ambiguous, as it could also be interpreted as: taking the model apart by "lifting" layers...