D3.1 Twinning and Training material toolkit

***IASON**:* Fostering sustainability and uptake of research results through Networking activities in Black Sea & Mediterranean areas

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[1] **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

[2] **PU** = Public, **PP** = Restricted to other programme participants (including the Commission Services), **RE** = Restricted to a group specified by the consortium (including the Commission Services), **CO** = Confidential, only for members of the consortium (including the Commission Services).

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ABBREVIATIONS

Term	Explanation
BSC-OS	Black Sea Catchment Observation System
CRASTE-LF	African Regional Centre for Space Science and Technology — in French Language
CSW	Catalog *Service* for the *Web*
DAT	Ministry of Urban and Land
EO	Earth Observation
GEO	group earth observation
GEOSS	Global Earth Observation System of Systems
gSWAT	hydrological model over the Grid and HPC infrastructure
ISO	International Organization for Standardization
KML	Keyhole Markup Language
OGC	Open Geospatial Consortium
PyWPS	Service Web in Python
SDI	Spatial Data Infrastructure
SLD	Styled Layer Descriptor
UNIGE	University of Geneva
UTCN	Technical University of Cluj-Napoca
WCS	Web Coverage Service
WFS	Web Feature Service
WMS	Web Mapping Service
WPS	Web Processing Service
FP7	Seventh Research Framework Programme
R&I	Research and Innovation

CONTENTS

EXECUTIVE SUMMARY

IASON Virtual Meeting Place (VMP) supports access of stakeholders, research institutes, and specialists to training and teaching materials regarding the applications and tools developed through various projects in the region. Users may develop themselves such presentations, and may consult other already created documents (i.e. as links, files, and eGLE materials). The IASON VMP solution has been built based on the eGLE platform, which supports the development of training and teaching materials. IASON VMP resources are included and available from the IASON Portal.

This document describes the concepts, architecture, implementation, and using of the Virtual Meeting Place in the IASON project.

1. INTRODUCTION

IASON Virtual Meeting Place (IVMP) constitutes a virtual meeting place that provides tools and support for communication between stakeholders, research institutes, and end-users. It enables sharing of training and teaching materials and supports users in integrating existing content or creating new resources. In synchronization with IASON project's main objectives IVMP aims to maximize the visibility of resources that have been already created in previous European projects and the benefits one can obtain from them.

2. IASON VIRTUAL MEETING PLACE

IASON Virtual Meeting Place has been developed based on eGLE Platform [1] and fully benefits from all its functionality and flexibility, empowering efficient twinning capabilities of previously developed materials and tools. The resources displayed in IVMP can be:

- created directly in IASON Virtual Meeting Place using eGLE capabilities
- created with external tools and updated into IASON Virtual Meeting Place
- created and already published in another IASON repository but presented also on IVMP

2.1 OGC standards

The OGC standards have been developed and maintained by the Open Geospatial Consortium [2] in order to support the information description, encoding and sharing between different entities. Ideally, two components developed separately that implement the OGC standards will work together out of the box (without any adjustments necessary).

The OGC Web Services (OWS) represent a subset of the OGC standards that have been developed to describe interoperability in World Wide Web applications. The most commonly services used today are:

- **Web Map Service (WMS)** – provides a simple HTTP interface for querying and retrieving geo-registered map images from distributed geospatial databases.

Retrieved images are usually codified as PNG and JPEG and can have transparent sections for display as overlays.

- **Web Coverage Service (WCS)** – represents a method of exposing multi-dimensional coverage data for access over the Internet, in different formats. Although no particular format is mentioned for data encoding, the recommended one is GML.
- **Web Coverage Processing Service (WCPS)** - defines a protocol-independent language for the extraction, processing, and analysis of multi-dimensional gridded coverages, in customized forms useful for third-party applications.
- **Web Processing Service** – standardizes the inputs and output formats for geospatial processing services and also defines how a client can request the execution of a process and retrieve the results.
- **Web Map Tile Service (WMTS)** – describes a standard approach under which an application can serve map tiles of spatially referenced data from predefined content images (resolution, extent).

Through the implementation of these standards the members of the IASON consortium and other third-party organizations can expose content and processing capabilities to be used in new applications. eGLE Application takes advantage of these resources by allowing content creators to twin them and present the information in a coherent manner to the visitors.

2.2 eGLE Platform

Created with extensibility in mind, eGLE Platform is based on a distributed architecture (see Figure 1) that enables out-of-the-box connectivity for standardized resources like OGC Web Services, HTTP accessible resources etc. At the same time, new connectors (named *tools*) can be created and included to manage the communication process with customized APIs. After registration into the platform, the use of any connector is very simple and straightforward: through drag-and-drop interactions any author can integrate the desired tools into his/her resources.

The development of eGLE Application has started in the European project GISHEO (On Demand Grid Services for High Education and Training in Earth Observation) [3] funded by European Space Agency through PECS Programme. It has been initially designed as a flexible and extensible eLearning Platform for empowering Earth

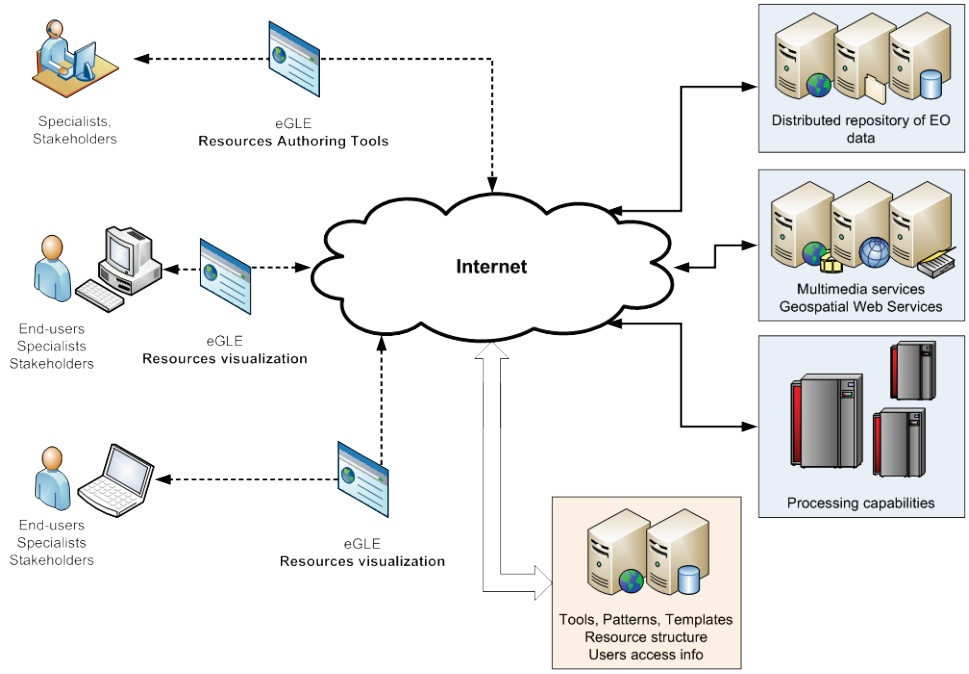

Figure 1 eGLE Platform architecture

Observation specialists without advanced technical background to create high quality and dynamic teaching materials [4]. Dedicated tools have been developed to access distributed repositories, visualize satellite images, and describe and execute Grid based processing [5].

During the European FP7 Project enviroGRIDS [6] the development of eGLE Application has addressed another challenge: real-time processing and twinning of distributed OGC web-services in the context of a learning resource [7]. Furthermore, data visualization and processing capabilities provided by BASHYT [8] platform have been also included into eGLE through a customized API [9]. Throughout the development process, the main objective of the eGLE Platform has remained the same: enabling specialists from EO domain without technical background to create teaching resources. The training component of the BSC-OS portal [10] has been created based on eGLE Application in order to enable specialists, stake-holders, and decision makers to create and share training materials and reports.

The profile of the target user for the application has the following main characteristics:

- is an EO scientist / decision maker that intends to create informative resources based on different EO specific processing (satellite images, sensor recorded data, hydrological or meteorological simulations, etc.)

- knows the basic concepts related with web resources, including basic understanding of user interaction types, pedagogical approaches, information presentation methods, etc.
- has no (or very little) technical knowledge about technologies like HTML, CSS, XML, JavaScript, etc. or concepts like distributed databases, mash-ups, web services and others
- has medium level computer operating skills that include internet browsing, basic knowledge about file formats (ex. image or video formats), files management operations, etc.

When creating resources, the authors can develop new elements specifically for the intended resource (images, processing results, video files, text, etc.), or can use already existing materials twined with the newly created ones and presented in an integrated and unified manner. This procedure, named *repurposing,* stimulates the improved quality of created materials as well as the efficiency of the development process and is natively supported in eGLE [11].

One of the major issues in the creation process is represented by the description of visual layout of the elements included inside the same resource. Usually, the layout formatting is defined in HTML and CSS languages, which can be generated by non-technical specialists only using different visual applications (ex. online rich text editors, wiki systems, forums, etc.). Due to the fact that these programs have been developed for other purposes and are not specialized in learning resources development, the formatting functionalities are rather limited and very restrictive, direct editing of the code being often necessary.

Addressing these problems, eGLE application provides specialized layout control and creation mechanisms for the visual representation of learning materials. The layout of the resources allows the integration of multiple instance connecting and presentational tools that can be active at the same time and are placed in a flexible grid like structure with three levels:

- **tools** - defined by the programmers previous to the resource creation time and made available for the authors. These are atomic elements specialized on a specific data type (e.g. text, image, slideshow, video, sound etc.). Every tool must implement the specific interface required for data binding and also the mechanism that will allow the author to control its behavior and display settings.

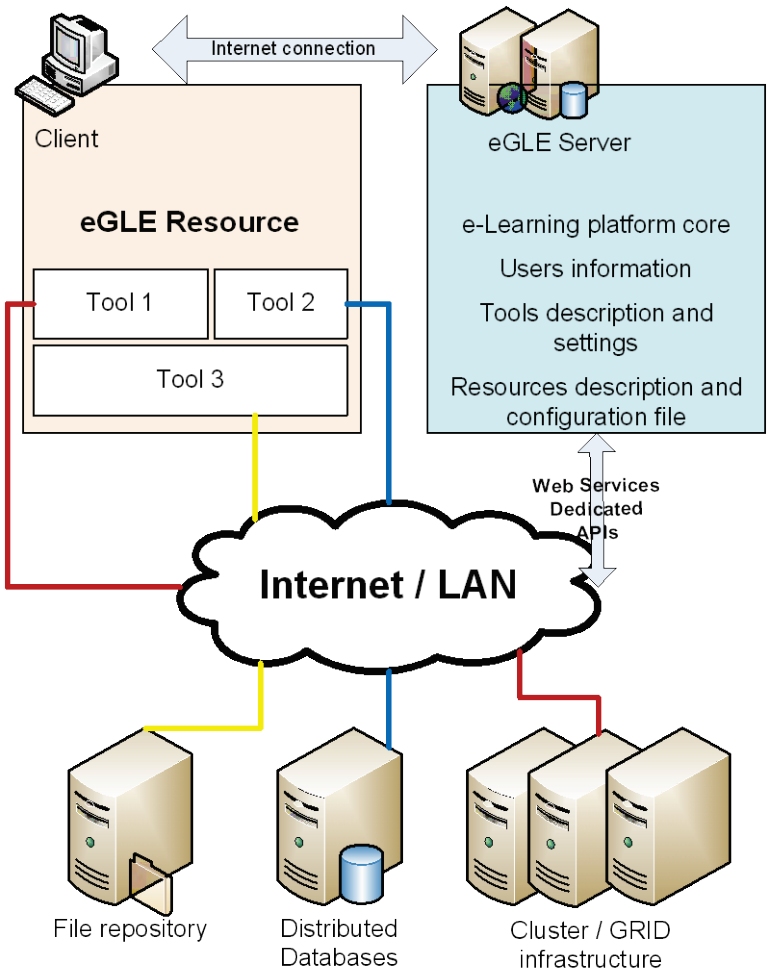

Figure 2 eGLE resource structure

- **patterns** - created directly by the authors previously or during the authoring time, the patterns represent general layout containers that logically group related information (e.g. image and its label, video and explanatory text, etc.). Authors can create patterns by combining the tools available into the platform and specifying their relative layout (e.g. the image label is displayed on top/on bottom, the text area is beneath the video area, or to the left/right etc.). Using patterns instead templates as logical information organizers, the resource reusing percent will increase significantly as it is more likely to have smaller identical layout areas in different resources than global identical layouts.
- **templates** - collections of patterns and global display settings (e.g. fonts for regular text, titles, image labels, paragraph styles, background colors, etc.). Are defined at authoring time by the authors.

As mentioned before, eGLE tools represent the atomic part of a resource that is specialized in handling all the aspects related with a specific data type: retrieval, display, user interactions. Furthermore, the tools can provide mechanisms for searching and accessing remote data repositories, communicate with dedicated APIs, describe and launch large-scale processing requests on GRID or Cloud infrastructures, interrogate OGC Web services, etc. Through this approach, the authors of eGLE resources have the possibility to retrieve remote pieces of information from other systems or databases through different connecting scenarios: web services, mash-ups, HTTP, streaming, etc. For specifying the connection settings and parameters, each tool provides to the user a visual interface that minimizes the need of technical knowledge.

For scalability and performance reasons, all the distributed connections from the tools included into a resource running on a visitor's computer and the remote providers are direct, without passing through the main eGLE web server (see Figure 2).

Through eGLE, all the authors have the ability to easily reuse resources created in previous European projects with minimal modifications and effort. They can connect processing results, available web services, remote data repositories, etc. in the same material, allowing the visitors to visualize all the information in a unitary and coherent manner. Furthermore, if the provided functionalities allow, the visitors can dynamically interact with the exposed APIs through eGLE tools (interrogate web services, design and launch processing requests on GRID or Cloud, etc.).

2.3 Unified display of IASON resources from distributed repositories

For increased visibility, improved flexibility and efficiency, IASON Virtual Meeting Place (IVMP) aims to enable access to all the public resources available in IASON projects through a single portal. This will enable all the IVMP users to consult the entire database of resources in a single place, encouraging a more coherent approach in data visualization, extraction and analysis.

Our purpose has been to obtain a unitary approach for all these distributed sources without replicating the data, creating a more complex management mechanism or replacing the already existing resources management systems.

Because the dynamic of the included resources can generate a different number of changes at different time intervals, the synchronization of the Virtual Meeting Place with external repositories can become very difficult. As a result we have decided to

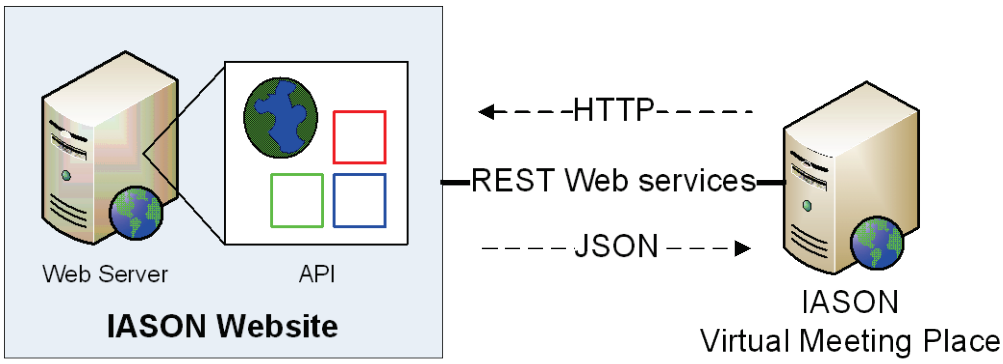

Figure 3 Communication between IASON Website and IVMP

dynamically include the available resources from external repositories on the fly, at the display time, through requests sent toward specific REST APIs hosted at distributed repositories locations.

For the integration of the resources displayed and maintained in IASON Knowledge Base (section of IASON website) we have developed a dedicated API (see Figure 3), based on HTTP requests and JSON encoded responses, with two services:

- getCategories (http://iason-fp7.eu/api/getCategories.php) – returns a list of available categories in Knowledge Base, according to the following format:

```
[{
"CATEGORY_ID": Number,
"CATEGORY_NAME": String
},{}...]
```

- getResources (http://iason-fp7.eu/api/getResources.php?cid=CATEGORY_ID) returns a list of all the available resources in the category identified through CATEGORY_ID, codified as shown below:

```
[{
"RESOURCE_ID": Number,
"RESOURCE_TITLE": String,
"RESOURCE_DESCRIPTION": String, HMTL format,
"RESOURCE_DATE": String,
"RESOURCE_AUTHOR": String,
"RESOURCE_LINK": String,
"RESOURCE_LICENSE": String,
"RESOURCE_VERSION": String
},{}...]
```

Figure 4 Same resource visible both in IASON Website and IASON Virtual Meeting Place

When displaying the available resources to the user, IASON Virtual Meeting Place interrogates these two services and integrates the results with the elements already existing in its own database (see Figure 4). For security reasons, the two services expose only publically available resources from Knowledge Base section of IASON website.

This simple and efficient approach can be applied to the integration of any other repositories available, in a transparent manner for the final user, who is able to browse all the resources in the same place.

2.4 Creating new training materials in IASON Virtual Meeting Place

The development of new materials in IASON Virtual Meeting Place is a process that can be completed by registered users that have the necessary knowledge in Earth Observation domain. Due to the support of eGLE interface, technical knowledge is not required, the aggregation and configuration of the available tools being carried out through simple and intuitive visual interfaces.

IASON Virtual Meeting Place, available at http://cgis.utcluj.ro/iason-vcenter/ (see Figure 5) provides to visitors a short introductory page, a list of available resources and

Figure 5 IASON Virtual Meeting Place home page

a restricted section reserved to registered members (that are also content creators). All the public resources, from the internal database of Virtual Meeting Place or from remote repositories are freely accessible to all the visitors, encouraging data exchange between interested parties.

In order to create new training materials the users must authenticate into the IVMP platform (see Figure 6) and identify the desired sections where the resources will be published (see Figure 7).

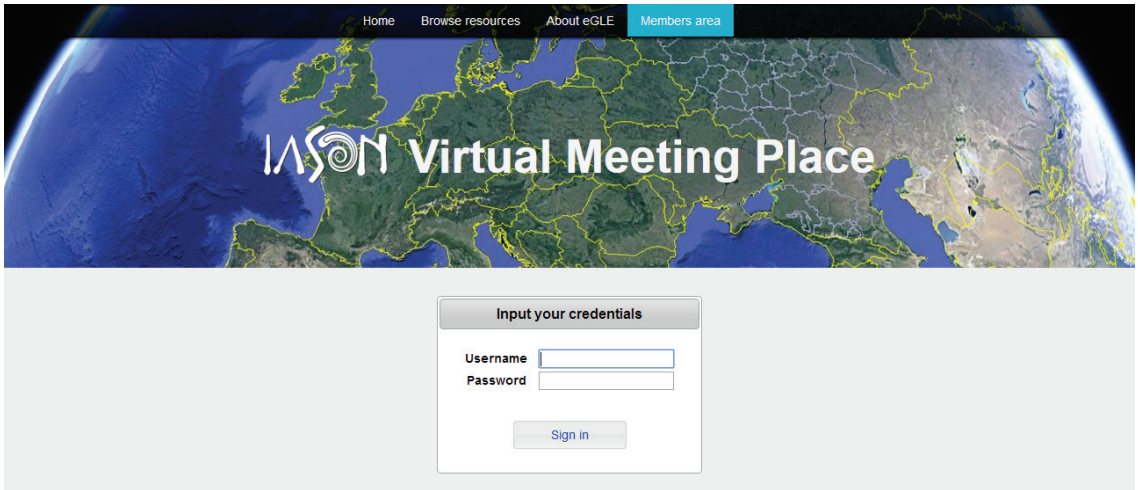

Figure 6 Only authenticated users can access IVMP to create training materials

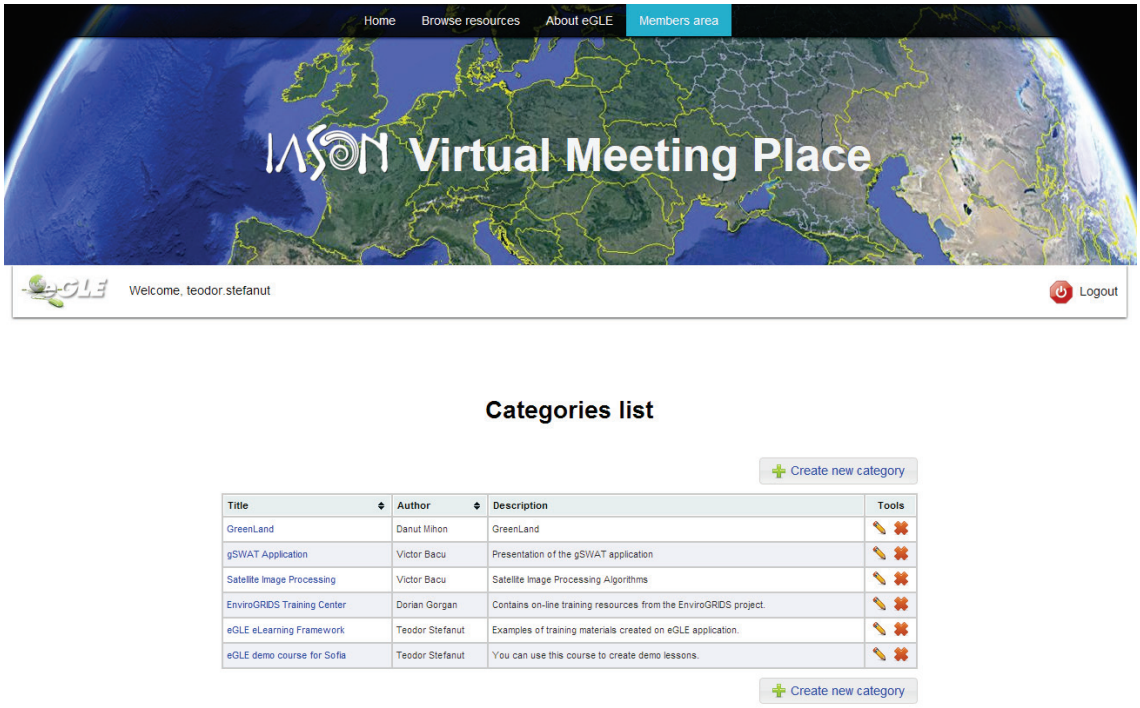

Figure 7 Available categories list for training materials in IASON Virtual Meeting Place

If required, a new category can be created at any time, by any user.

After defining a title and a description for the new resource, the author is able to start describing its structure and organize the content to be displayed.

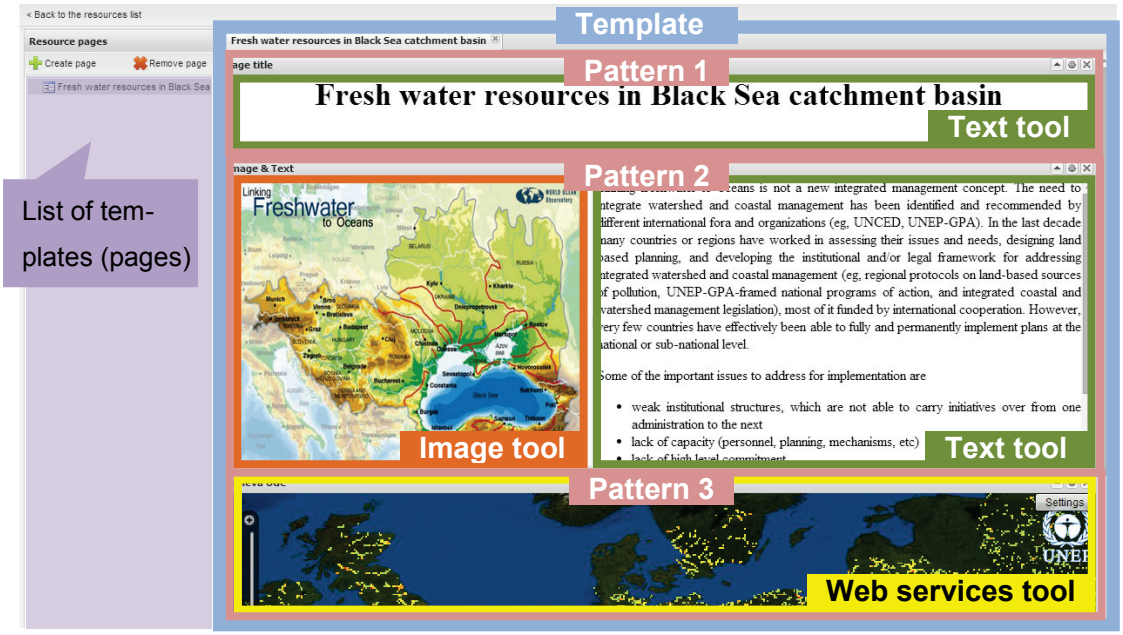

Figure 8 eGLE training resource visual structure

As presented in section 2.1, the visual structure of any resource is a hierarchical structure of *templates*, *patterns* and *tools* (see Figure 8). For simplicity, a pattern can be virtually represented as a structural row into the resource. On the same idea, the tools included into the pattern could be seen as columns.

While the number of patterns into a template is not limited, the number of tools in a pattern is restricted by the minimum horizontal display area required by each tool to be represented properly. At the same time, the number of templates (named also *pages* for a more common reference) in a resource is unrestricted.

2.4.1 Patterns management

The creation of a new pattern requires from the user a *title*, a *description* and the *list of tools* that will be included, as presented in Figure 9. It is highly recommended to name and describe the pattern in a general way, with emphasis on the types of the included tools and not on the content that will be displayed through those tools, as the pattern may be reused by others in different contexts to display different data types.

The list of tools can be defined by the author through drag & drop interactions from the **Available tools** list (placed on left side) into the **Chosen tools** list (placed on the right). The order of the tools in the former control is very important, as it represents the left-to-right display of the actual content. Reordering is permitted either through insertions (when adding a new tool to the pattern) or through drag & drop reordering actions on the **Chosen tools** list.

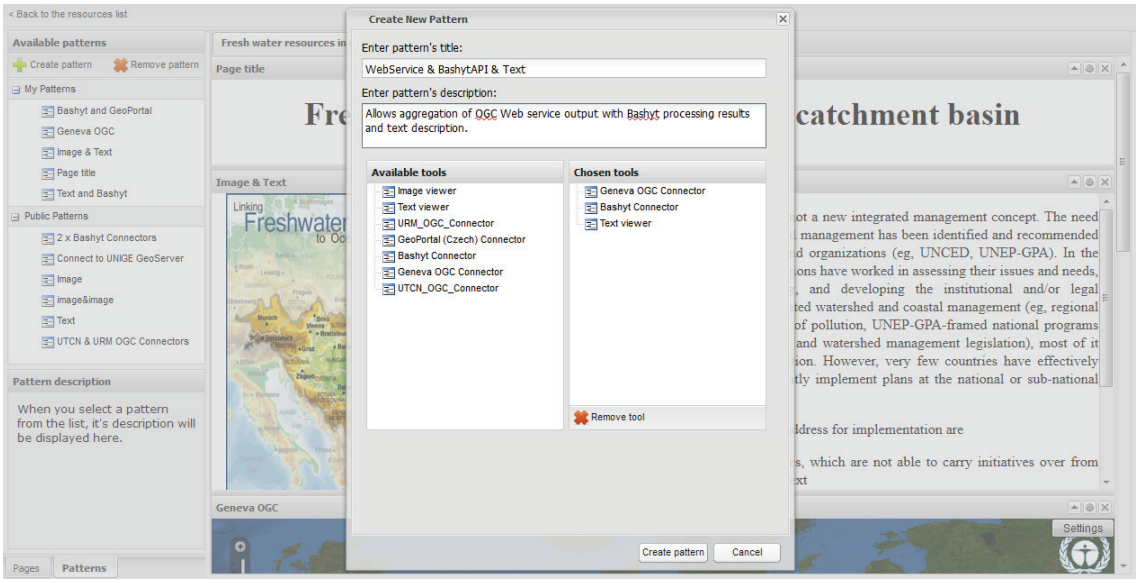

Figure 9 Creating a new pattern in eGLE

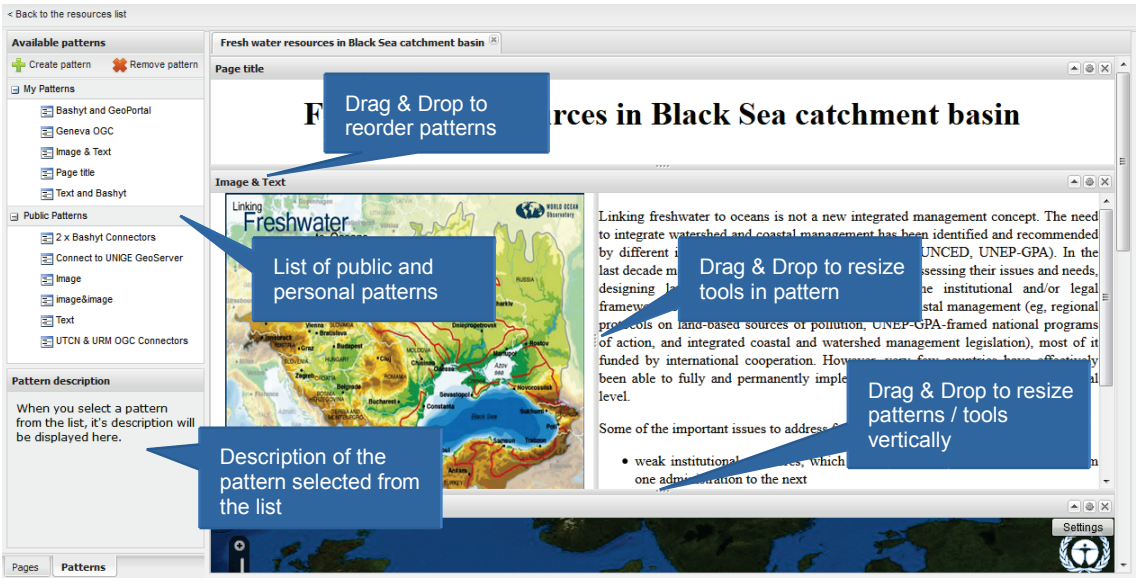

Figure 10 Patterns management and visual formatting in eGLE

All the available templates (personal and public) are displayed by the system in the left side of the authoring screen (see Figure 10), allowing the author to insert them into the active page through double-click or contextual menu option. After insertion, the patterns can be reordered vertically through drag&drop by the title bar and can be vertically resized through drag&drop by the bottom handle (see Figure 10). The vertical change in size of the pattern will be automatically reflected on the contained tools.

For horizontal resizing of the tools inside each patter, eGLE interface provides drag&drop handles between each adjacent tools. Patterns are always bound to cover the entire with of the template and tools are configured to display the entire area of the patterns. As a result, the resizing actions performed over one tool will be automatically reflected on the adjacent tool too (when one gets narrower the other one gets wider and vice versa).

2.4.2 Tools configuration

As mentioned in section 2.1 each tool included in eGLE implements required mechanisms for: communication protocols, data retrieval (from local or remote repositories), information display and user interactions. For simplicity, it is recommended to focus each tool on specific data types and to present users with simple, focused and intuitive configuration interfaces (see Figure 11).

All tools have two main running modes:

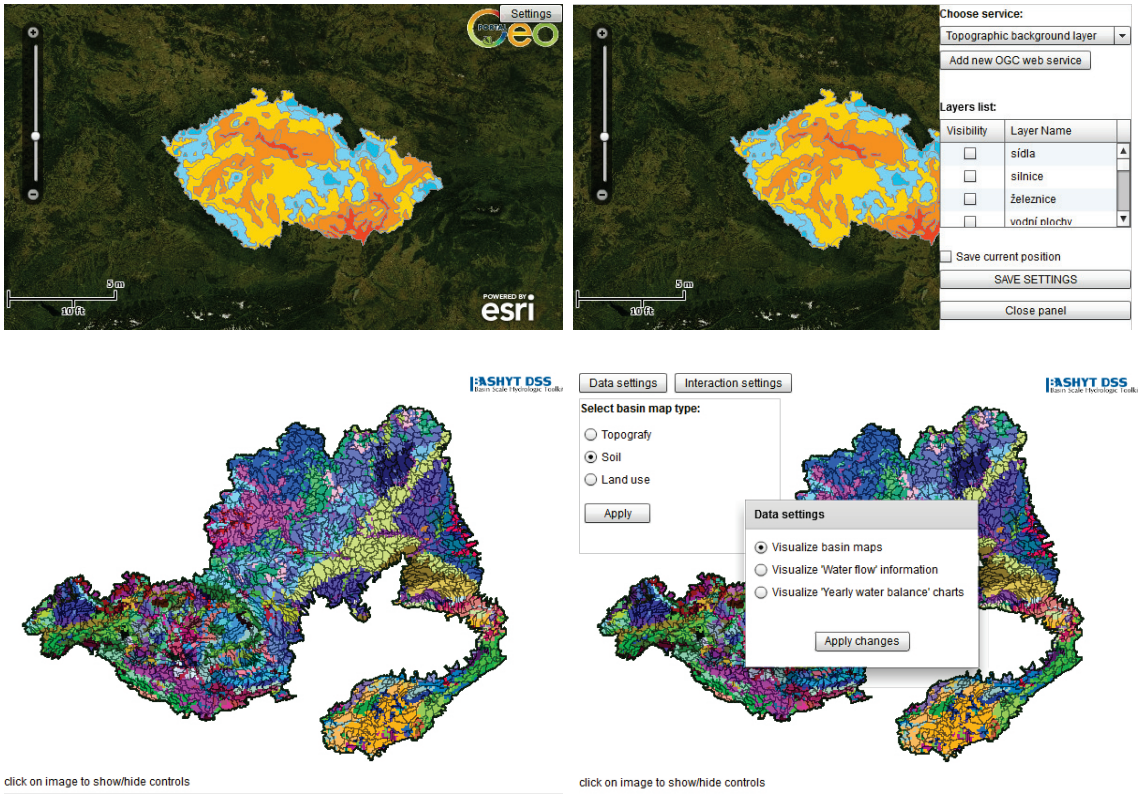

Figure 11 Example of tools configuration interfaces: OGC web services (top), dedicated Bashyt API (bottom)

- **edit mode** – at authoring time, when the author of a resource must setup the required parameters for data retrieval and information display as well as the desired user interaction capabilities: *static* or *dynamic* interaction.
- **visualization mode** – at visiting time, when the tool must display to the current user the information prepared by the author and, if applicable, support the visitor in making queries or launching processing requests.

For example, an author is interested in presenting to his visitors processed satellite images that reflect the flooding areas modification over 40 years on the entire Europe. The images are stored into a repository that exposes an OGC compliant API. In order to include these resources in his training materials one may try to: (a) include all the available images as static resources; (b) include a large number of OGC specialized tools that make specific queries to the API and display retrieved data; (c) include only a few OGC tools that enable the visitor to query the API by himself and extract desired information.

In both (a) and (b) approaches the effort of creating the resource is significantly higher than in approach (c), while the end-result can be less satisfactory. Covering all display possibilities on a large dataset at authoring time is virtually impossible and visitors may not find the desired data even if the information actually exists in the dataset. On the other hand, if the visitors have the ability to query the data source within bounds established by the author and through an intuitive interface provided by the tool, they will be able to identify and consult desired information much easier.

3. INFORMATIVE PUBLICATIONS

This action will develop and distribute informative publications, and best practice guidelines that will help all relevant actors in the regions to form regional networks and create bridges between existing thematic networks in the region.

The informative publications consisting of various documents (e.g. files, links, eGLE materials) will be available through the VMP environment. UTCN partner provides a few examples of training materials, developed by eGLE application, concerning the applications GreenLand and gSWAT, and the enviroGRIDS BSC-OS Portal.

Best practice guidelines on developing EO information publications by eGLE application will be developed and provided as well.

4. CONCLUSIONS AND RECOMMENDATIONS

The IASON Virtual Meeting Place is a simple way of accessing diverse documents and tools available for the IASON related community of specialists. Actually VMP publishes documents from IASON Portal and remotely linked documents, and training and teaching materials already created by eGLE Platform.

The Earth Science specialists may develop themselves new training and teaching materials by using interactively the eGLE tools.

One recommendation concerns with the extension of the IASON VMP to publish more information from the IASON PNF database. One simple and flexible solution to support this feature is to develop components for API (Application Programming Interface) such as REST services in order to fetch and visualize information from IASON PNF.

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