



UNESCO-IHE
Institute for Water Education



Virtual Training Center based on eGLE eLearning Platform



MINISTRY OF EDUCATION AND RESEARCH



TECHNICAL UNIVERSITY
OF CLUJ-NAPOCA

CGIS
Computer Graphics
and Interactive Systems

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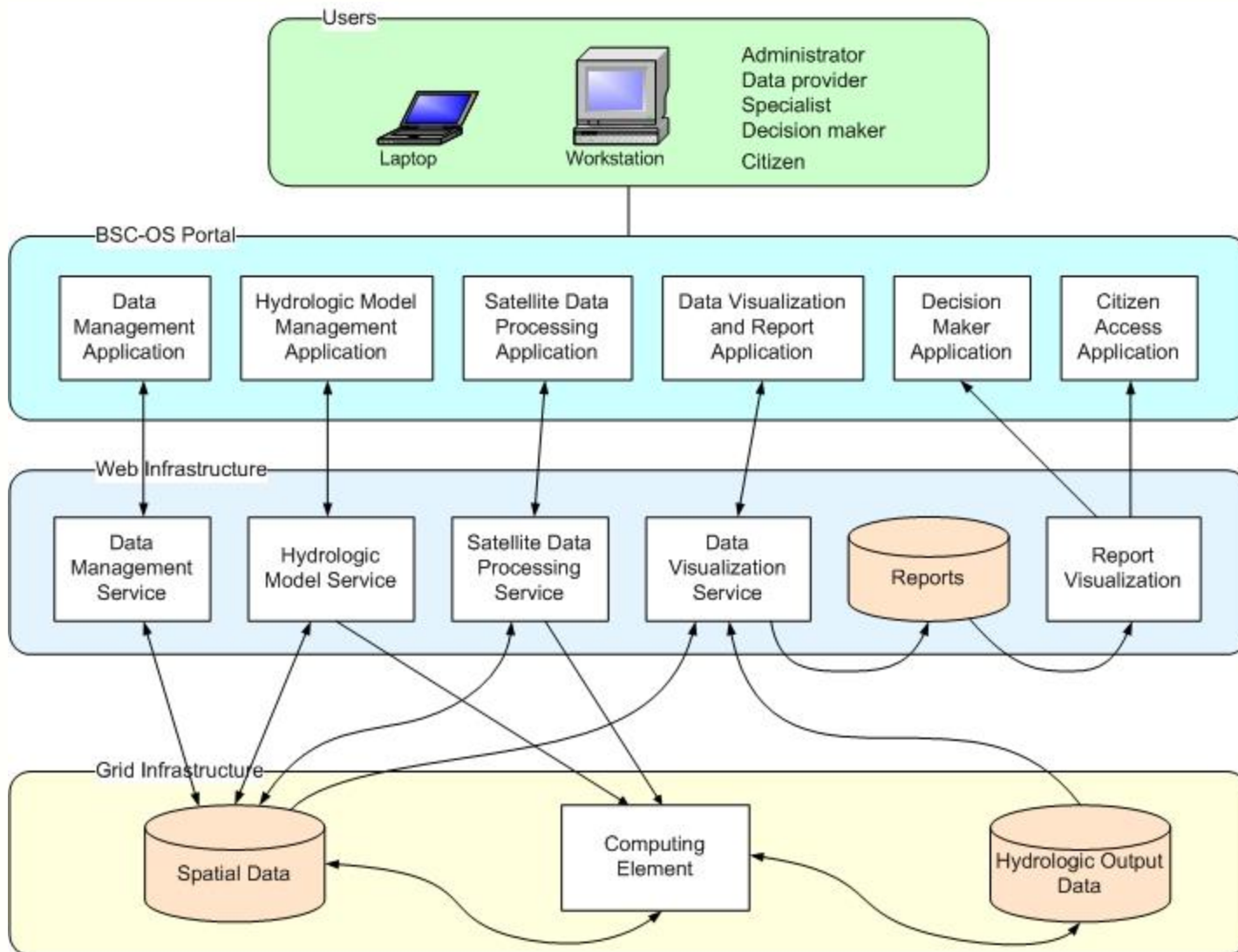
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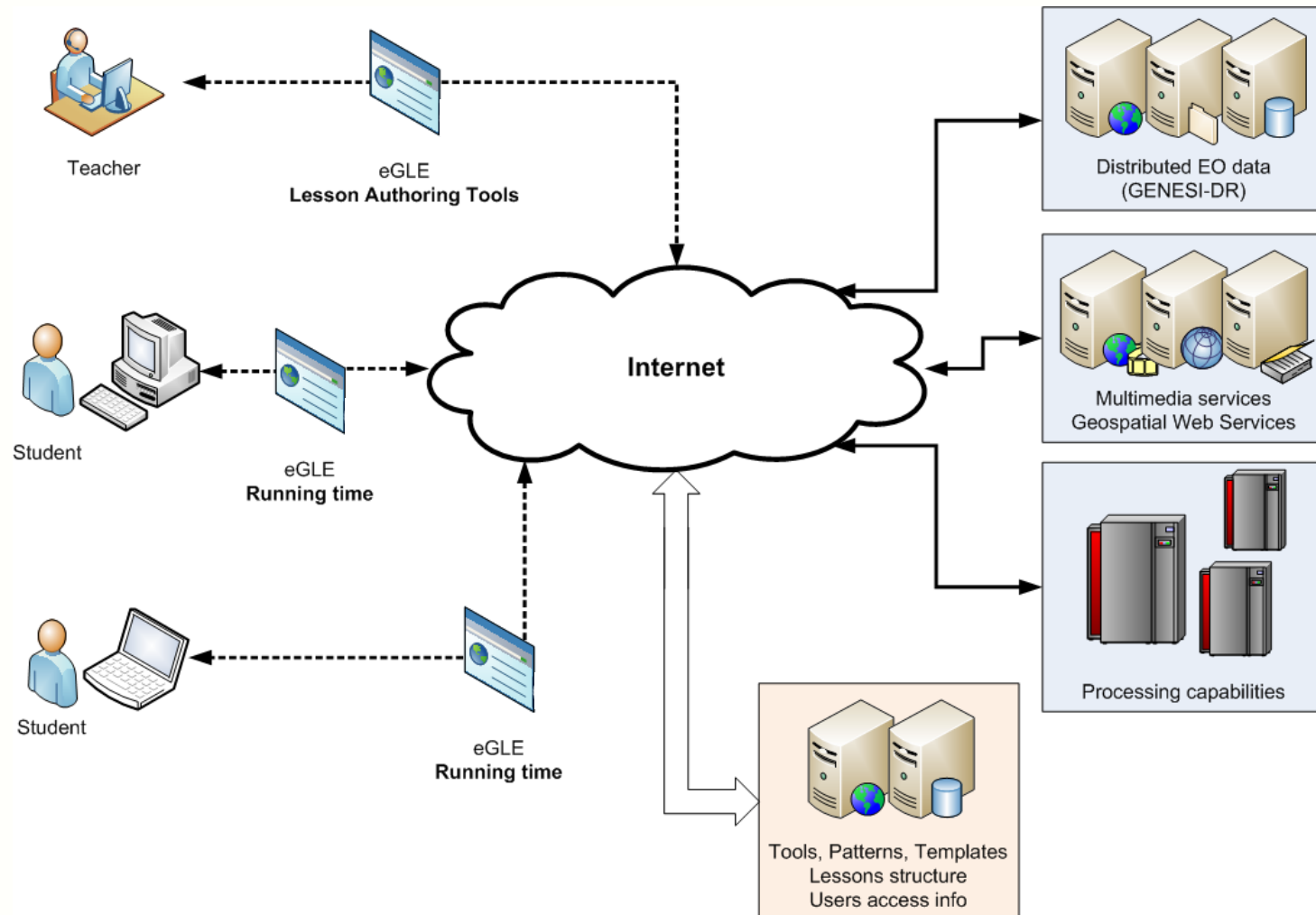
- enviroGRIDS portal architecture
- eGLE Platform
 - objectives, architecture, implementation scenario, functional levels, data and processing flow
- Lessons
 - visual structure, data types that can be included in eGLE lessons, lessons scenarios, execution (interactive scenario), examples
- Tools
 - pilot tools developed for eGLE, tool instantiation and interaction setup example
- Conclusions
- eGLE related projects
- Acknowledgements

enviroGRIDS portal architecture

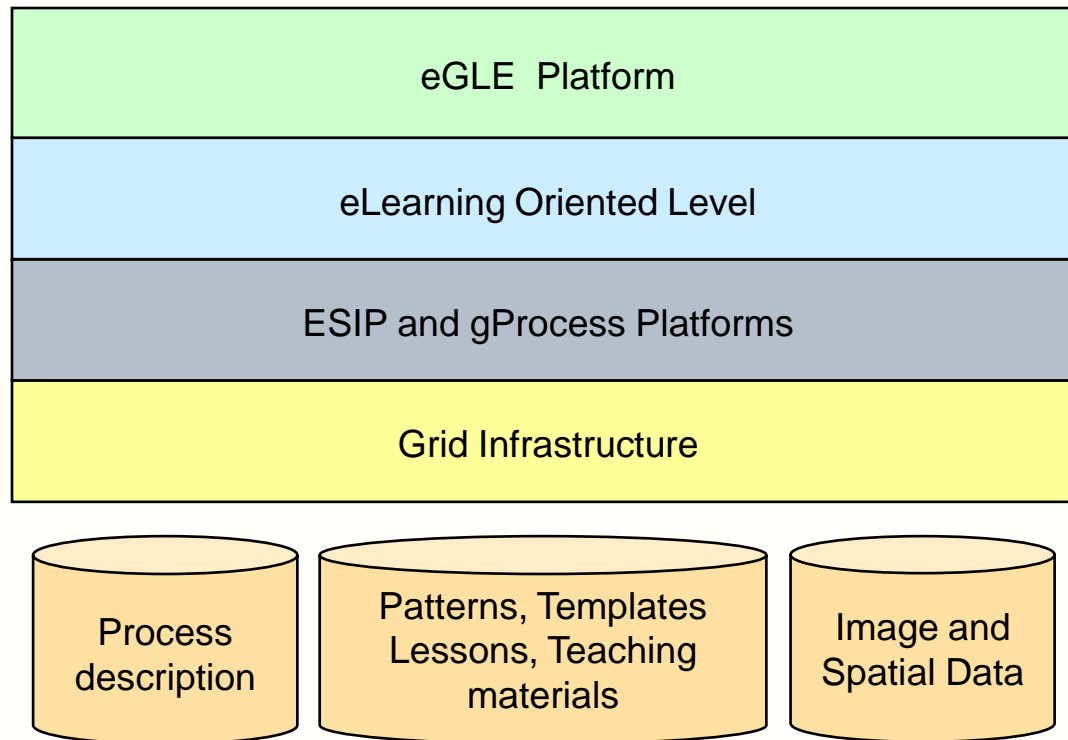


- ❑ Allow teachers with non-technical background to create and execute lessons for Earth Observation, based on GRID architecture
- ❑ Provide easy-to-use tools for data search and retrieval from remote repositories, data processing description, launch and monitoring over the GRID
- ❑ Allow different interaction levels with the students involved in the learning process:
 - ❑ modify the input data of a specific processing
 - ❑ describe and launch a new processing over the GRID
- ❑ Provide tools for online lessons development and visual data presentation

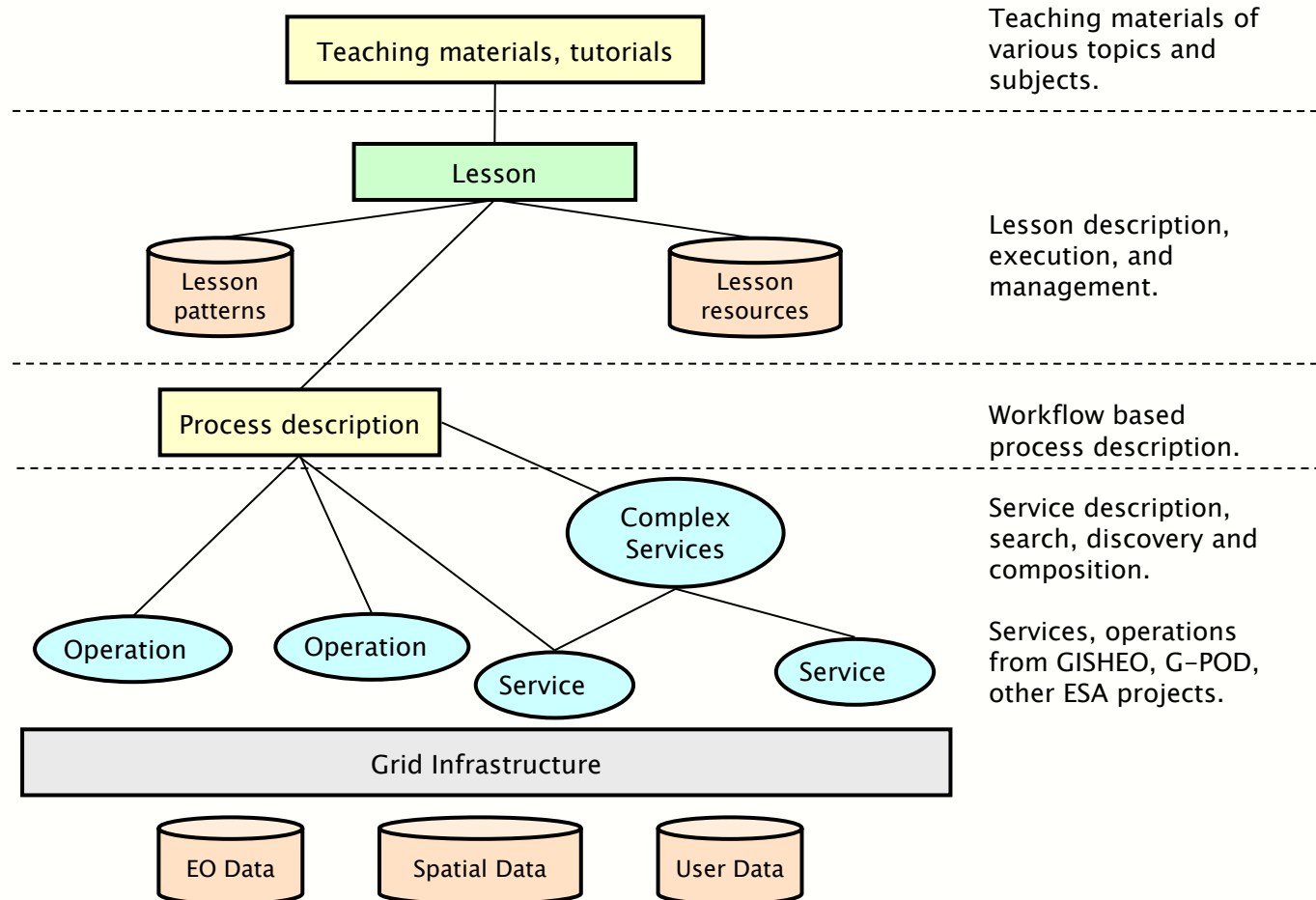
eGLE platform architecture



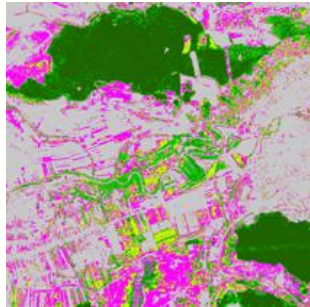
Functional levels in eGLE architecture



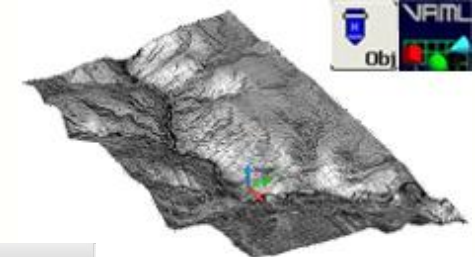
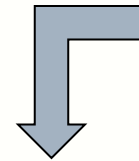
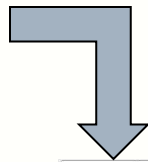
Data and processing flow



eGLE: lesson visual structure and data types



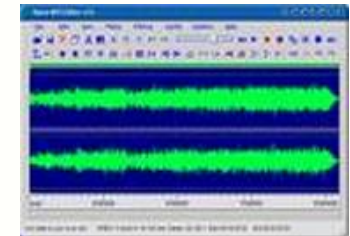
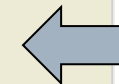
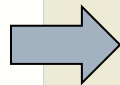
Images



3D Objects



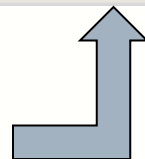
Videos



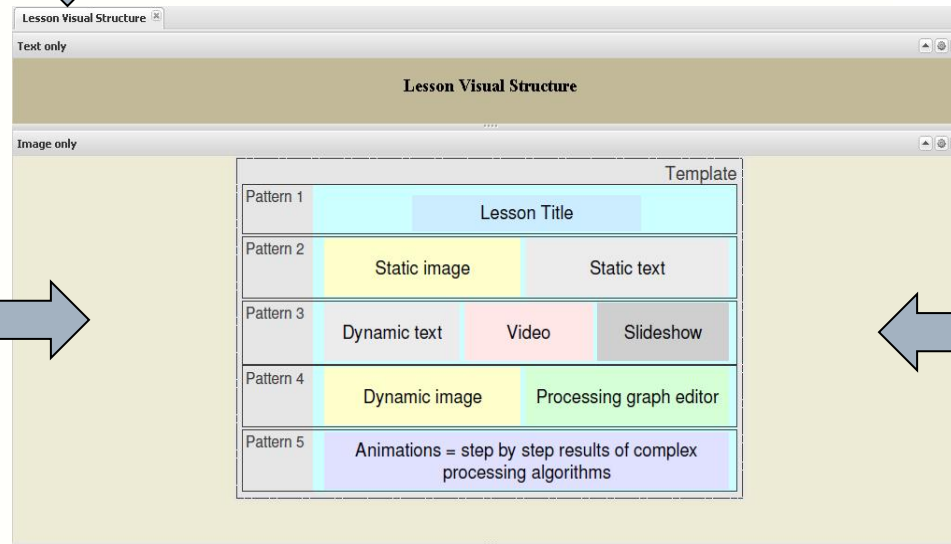
Sounds



Documents



Other multimedia content

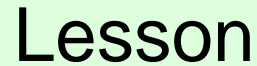


□ Static

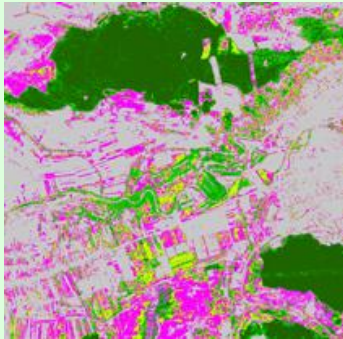
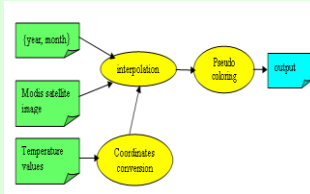
- All the content of the lesson is prepared in advance by the teacher, who can use its credentials to access protected information in different repositories
- The text, images, videos and all other components are pre-processed on the grid at authoring time and the results are stored into the database

□ Dynamic

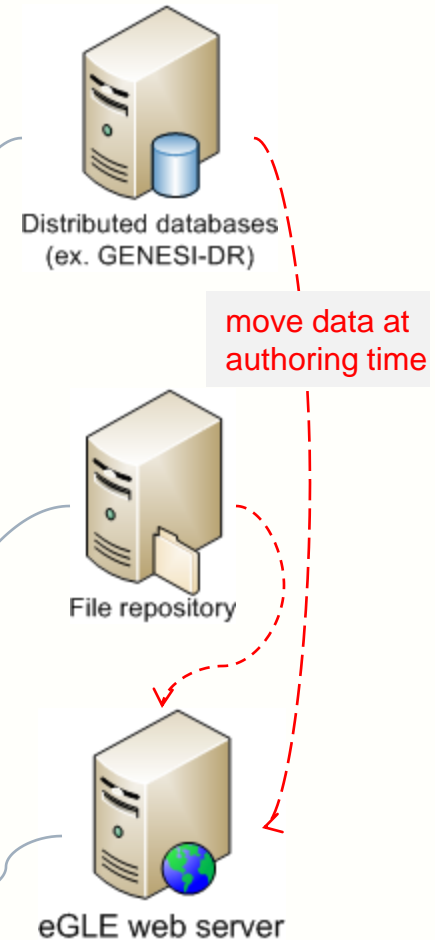
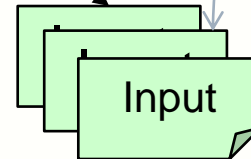
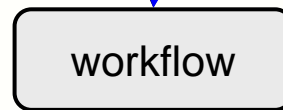
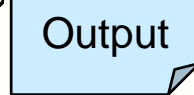
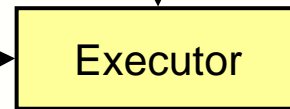
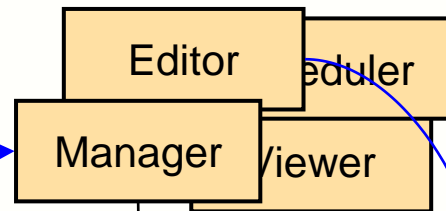
- The teacher describes a processing algorithm through a workflow using gProcess and grants to the students the ability to modify the workflow
- At runtime the students have the possibility to change the workflow and to execute the modified version over the Grid network



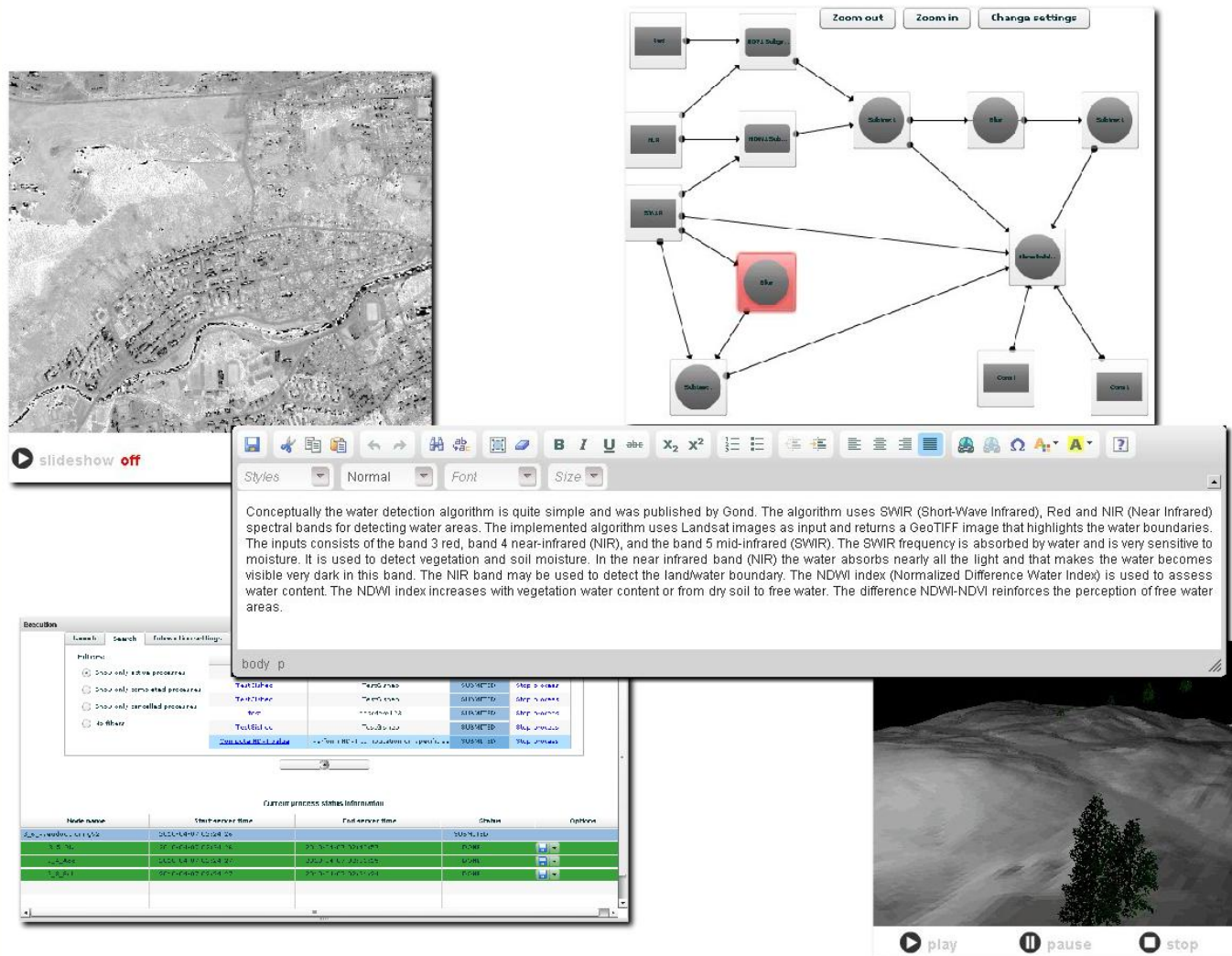
This lesson exemplifies interactive scenario for teacher and students.



ESIP platform



eGLE pilot tools



The interface displays a satellite map on the left, a workflow diagram on the top right, a text window in the center, and a video player on the bottom right.

Workflow Diagram: A flowchart showing the process from input bands (TIR, NIR, SWIR) through various processing steps (e.g., NDWI, NDVI, NDWI-NDVI) to a final output (Water). A red box highlights the 'NDWI' step.

Text Window: Contains the following text:

Conceptually the water detection algorithm is quite simple and was published by Gond. The algorithm uses SWIR (Short-Wave Infrared), Red and NIR (Near Infrared) spectral bands for detecting water areas. The implemented algorithm uses Landsat images as input and returns a GeoTIFF image that highlights the water boundaries. The inputs consists of the band 3 red, band 4 near-infrared (NIR), and the band 5 mid-infrared (SWIR). The SWIR frequency is absorbed by water and is very sensitive to moisture. It is used to detect vegetation and soil moisture. In the near infrared band (NIR) the water absorbs nearly all the light and that makes the water becomes visible very dark in this band. The NIR band may be used to detect the land/water boundary. The NDWI index (Normalized Difference Water Index) is used to assess water content. The NDWI index increases with vegetation water content or from dry soil to free water. The difference NDWI-NDVI reinforces the perception of free water areas.

Video Player: Shows a 3D visualization of a landscape with a tree in the foreground and a body of water in the background. Controls include play, pause, and stop buttons.

eGLE lessons samples



A screenshot of the eGLE web application interface. On the left is a sidebar with icons for Users, Courses, My students, and Logout. The main area displays a list of lesson pages: "Image Processing and Analysis", "Introduction", and "Spectral Characteristic of Rocks and Minerals". The "Image Processing and Analysis" page is selected and shown in a larger window. It has a blue header with the title "Hydrothermal Alteration" and contains two paragraphs of text. The first paragraph discusses the goals of the research, and the second paragraph discusses the geological exploration approach. A "back to lessons list" link is visible at the bottom of the page.

Mineral Explorations by Landsat Image Ratios

Contents

- [Introduction](#)
- [Spectral Characteristic of Rocks and Minerals](#)
- [Image Processing and Analysis](#)

Hydrothermal Alteration

One of the main goals of the research reported by this paper is to analyze an approach for searching economic ore minerals. An economic deposit might in fact have a very low percentage of the mineral we are looking for. For example, gold may be economically mined at great depth at 5 ppm (5 grams in a ton of rock!). Actually, we cannot always look directly for the economic mineral spectrum in the image. Furthermore, often the economic mineral may not have a particularly separable spectrum in the wavelengths we are using.

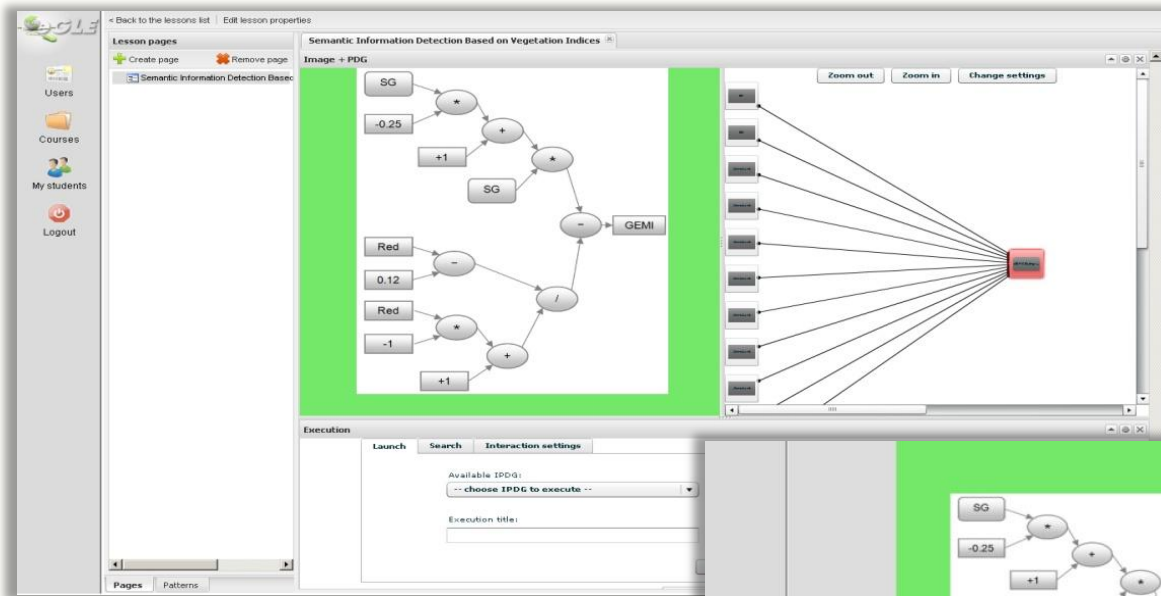
A typical geological exploration approach is therefore to build a model of associated minerals or environments where the economic mineral might be. We shall use the association of hydrothermal alteration with economic minerals in order to find target exploration areas. Hydrothermal alteration occurs when hot fluids invade the host rocks, interact chemically with it and alter the mineral composition. As the fluids cool, they precipitate minerals. They also tend to change the host rock lithology by hydrothermal alteration. The hydrothermally altered host rocks contain distinctive assemblages of secondary minerals, called alteration minerals that replace original minerals. Actually, not all alterations are associated with mineral deposits and as well not all mineral deposits means alteration rocks. In this paper we try to identify the types of altered rocks, which have been changed by the hot waters that often also carry economic minerals, according with the valuable indicators of possible deposit presented by Sabins in [8].

Ratio Technique Using Landsat Data

Band ratio is a technique that has been used for many years in remote sensing to effectively display spectral variations [5]. A ratio is created by dividing brightness values, pixel by pixel, of one band by another. The primary purpose of such ratios is to enhance the contrast between materials by dividing brightness values at peaks and troughs in a spectral reflectance curve. This tends to enhance spectral differences and suppress illumination differences. Ratios can be used to differentiate materials if those materials have different characteristic spectra. The band ratios of Landsat ETM+ data

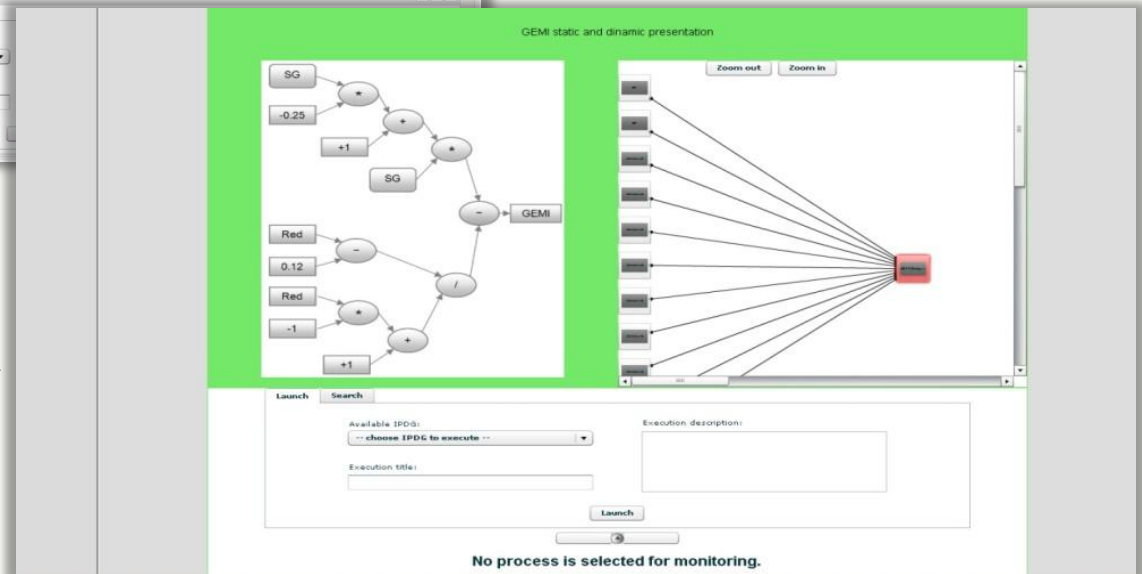


eGLE lessons samples

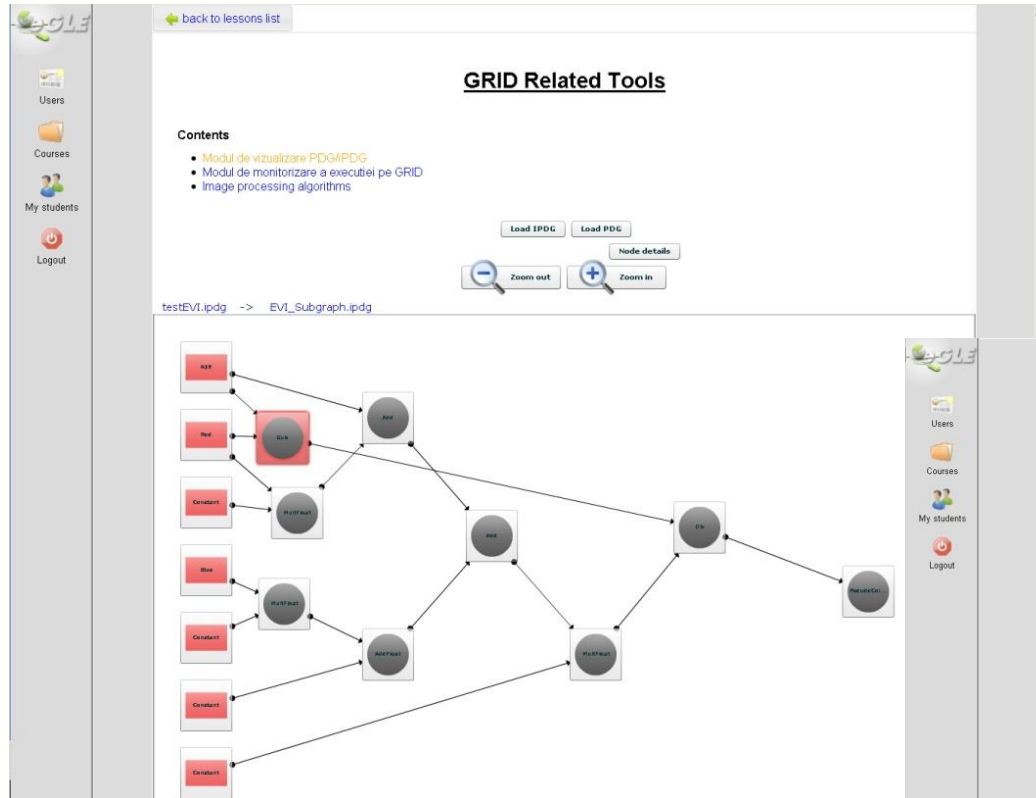


Runtime

Authoring (WYSIWYG editor)



Lesson sample – GRID oriented tools



back to lessons list

GRID Related Tools

Contents

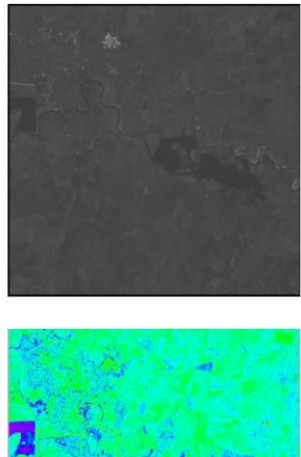
- Modul de vizualizare PDG4PDG
- Modul de monitorizare a execuției pe GRID
- Image processing algorithms

NDVI - normalized difference vegetation index

The **Normalized Difference Vegetation Index (NDVI)** is a simple numerical indicator that can be used to analyze remote sensing measurements, typically but not necessarily from a space platform, and assess whether the target being observed contains live green vegetation or not.

Live green plants absorb solar radiation in the photosynthetically active radiation (PAR) spectral region, which they use as a source of energy in the process of photosynthesis. Leaf cells have also evolved to scatter (i.e., reflect and transmit) solar radiation in the near-infrared spectral region (which carries approximately half of the total incoming solar energy), because the energy level per photon in that domain (wavelengths longer than about 700 nanometers) is not sufficient to be useful to synthesize organic molecules. A strong absorption at these wavelengths would only result in over-heating the plant and possibly damaging the tissues. Hence, live green plants appear relatively dark in the PAR and relatively bright in the near-infrared. By contrast, clouds and snow tend to be rather bright in the red (as well as other visible wavelengths) and quite dark in the near-infrared.

Since early instruments of Earth Observation, such as NASA's ERTS and NOAA's AVHRR, acquired data in the red and near-infrared, it was natural to exploit the strong differences in plant reflectance to determine their spatial distribution in these satellite images. The NDVI is calculated from these individual measurements as follows:

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$


eGLE: Tools instantiation and student interaction setup



Execution

Launch Search Interaction settings

Available IPDG: **NDVI**

Execution title:

Execution description: Perform NDVI computation on specific satellite images.

Launch

No process is selected for monitoring.

Execution

Launch Search Interaction settings

Filters:

- ☒ Show only active processes
- ☐ Show only completed processes
- ☐ Show only cancelled processes
- ☐ No filters

Process name	Description	Status	Cancel
TestGisheo	TestGisheo	SUBMITTED	Stop process
TestGisheo	TestGisheo	SUBMITTED	Stop process
TestGisheo	TestGisheo	SUBMITTED	Stop process
test	descriere123	SUBMITTED	Stop process
TestGisheo	TestGisheo	SUBMITTED	Stop process

Compute NDVI value

Execution

Launch Search Interaction settings

Processes that can be monitored by students:

Title	Description
Compute NDVI value	Perform NDVI computation
TestGisheo	TestGisheo

Add Remove

IPDG's that can be launched in execution by students:

Title	Description
EVI	EVI Vegetation Index
IPVI	IPVI Vegetation Index
NDVI	NDVI Vegetation Index
SAVI	SAVI Vegetation Index

Add Remove

Save these settings

Current process status information

Node name	Start server time	End server time	Status	Options
3_6_PseudoColoringV2	2010-04-07 02:24:26		RUNNING	
3_5_Div	2010-04-07 02:24:26	2010-04-07 02:40:57	DONE	
3_4_Add	2010-04-07 02:24:27	2010-04-07 02:31:15	DONE	
3_3_Sub	2010-04-07 02:24:27	2010-04-07 02:31:24	DONE	

Conclusions



- ❑ Using eGLE platform the teachers are able to create complex lessons in EO domain without having knowledge on Grid technologies or distributed data repositories
- ❑ eGLE provides the development tools needed to create teaching materials in Earth Observation for schools, high schools, universities and companies, for training purposes
- ❑ Through its Tools, eGLE Application can incorporate the necessary functionalities for automated data search and retrieval from already existing distributed repositories (such as GENESI-DR)
- ❑ The teachers and even the students can visualize and launch large scale computing operations on satellite images, using transparently the Grid processing resources and facilities
- ❑ eGLE uses Grid and can be extended very easy to any complex processing based on Web services or Cloud Computing (for example integrating already developed Geospatial Web Services like WMS, WCS, WFS, WPS etc.)
- ❑ The modular structure of eGLE application allows the integration of new Tools which could encapsulate any new functionalities, implemented in various technologies



Acknowledgements



- eGLE (GiSHEO eLearning Environment) has been developed through the GiSHEO Project – On Demand Grid Services for High Education and Training in Earth Observation, and supported by European Space Agency through the ESA PECS Arrangement no. 98061 (2008 – 2010).
- eGLE has explored in the development and testing phases the use of spatial data repositories and services provided by the GENESI-DR Project: Ground European Network for Earth Science Interoperations – Data Repository, co-funded by the European Commission (Contract no. 212073, 2008 – 2009).
- To test the Grid based processing eGLE has used the SEE-GRID Infrastructure by collaboration with the SEE-GRID-SCI Project: SEE-GRID eInfrastructure for regional eScience, co-funded by the European Commission (Contract no. 211338, 2008 - 2010).



Thank you !

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