

MINISTRY OF EDUCATION AND RESEARCH



TECHNICAL UNIVERSITY
OF CLUJ-NAPOCA

CGIS
Computer Graphics
and Interactive Systems

Earth Science Oriented Applications in CGIS Laboratory

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Specific Technical Objectives

- Explore huge spatial data (i.e. satellite images) to supply information on the earth surface, weather, climate, geographic areas, pollution, and natural phenomena
- Support many variables based processing - satellite image type (e.g. MODIS, Landsat), geographic area, soil composition, vegetation cover, season, and context (e.g. clouds)
- Develop tools and components to support the development of Distributed Architecture (i.e. HPC, Grid and Cloud) based EO (Earth Observation) applications
- Develop and experiment the EO Application Development Methodology
- Flexible description, instantiation, scheduling and optimal execution of the Grid processing

- Computer Graphics and Interactive Systems Laboratory (CGIS) carry out research in computer graphics, Grid computing, spatial data modeling and processing, distributed interactive systems, graphic cluster based processing
- Develops Grid oriented tools, platforms and applications
 - gSWAT, gSWATSim
 - GreenLand v3
 - eGLE
 - ESIP, gProcess
 - GreenView
 - Greenland v1, Waterland, and Minerals applications
- Involved in enviroGRIDS VO, EGEE GEAR VO, SEE-GRID VO, Ro-GRID NGI
- Grid related research projects: enviroGRIDS, SEE-GRID-SCI, GiSHEO, mEducator, MedioGrid, COST IC0805

Grid Related Projects



- [EnviroGRIDS](#), Black Sea Catchment Observation and Assessment System supporting Sustainable Development, FP7 project, co-funded by the European Commission (2009 - 2013).



- [mEducator](#), Multi-type Content Repurposing and Sharing in Medical Education, eContentplus/ Digital Content and Cognitive Systems Programme. Funded by the European Commission (2009-2012).



- [GiSHEO](#), On demand Grid services for high education and training in Earth Observation, ESA-PECS project, Funded by European Space Agency through PECS Programme (2008-2010).



SEE-GRID-SCI
SEE-GRID eInfrastructure for regional eScience

- [SEE-GRID-SCI](#), SEE-GRID eInfrastructure for regional eScience, FP7 project, co-funded by the European Commission (2008 - 2010).



- [MEDI GRID](#), Parallel and distributed graphical processing on grid structure of geographical and environmental data. CEEX National Project (2005-2008).

Computing Resources in enviroGRIDS VO

- UTCN (Technical University of Cluj-Napoca)
RO-09-UTCN, 128 quad-core (512 core processors), and 12 TB.

- UVT (West University of Timisoara)
RO-08-UVT, joins the enviroGRIDS VO by 10 Working Nodes (WN) (CPU: 1.6 GHz Core2Duo, RAM: 2GB/node, HDD: 160GB, Network: 1Gbps, Services: MPI_WN); One Storage Element (SE) of 800GB.

- UPB (University Politehnica of Bucharest)
RO-03-UPB, 386 physical core processors, storage of 40 TB.

- ICI (National Research Institute in Informatics)
RO-01-ICI, has 12 WN in production (gLite), and SE of 1 TB.





- **EnviroGRIDS** - Gridifying the Black Sea catchment to support its sustainable development

<http://www.envirogrids.net/>

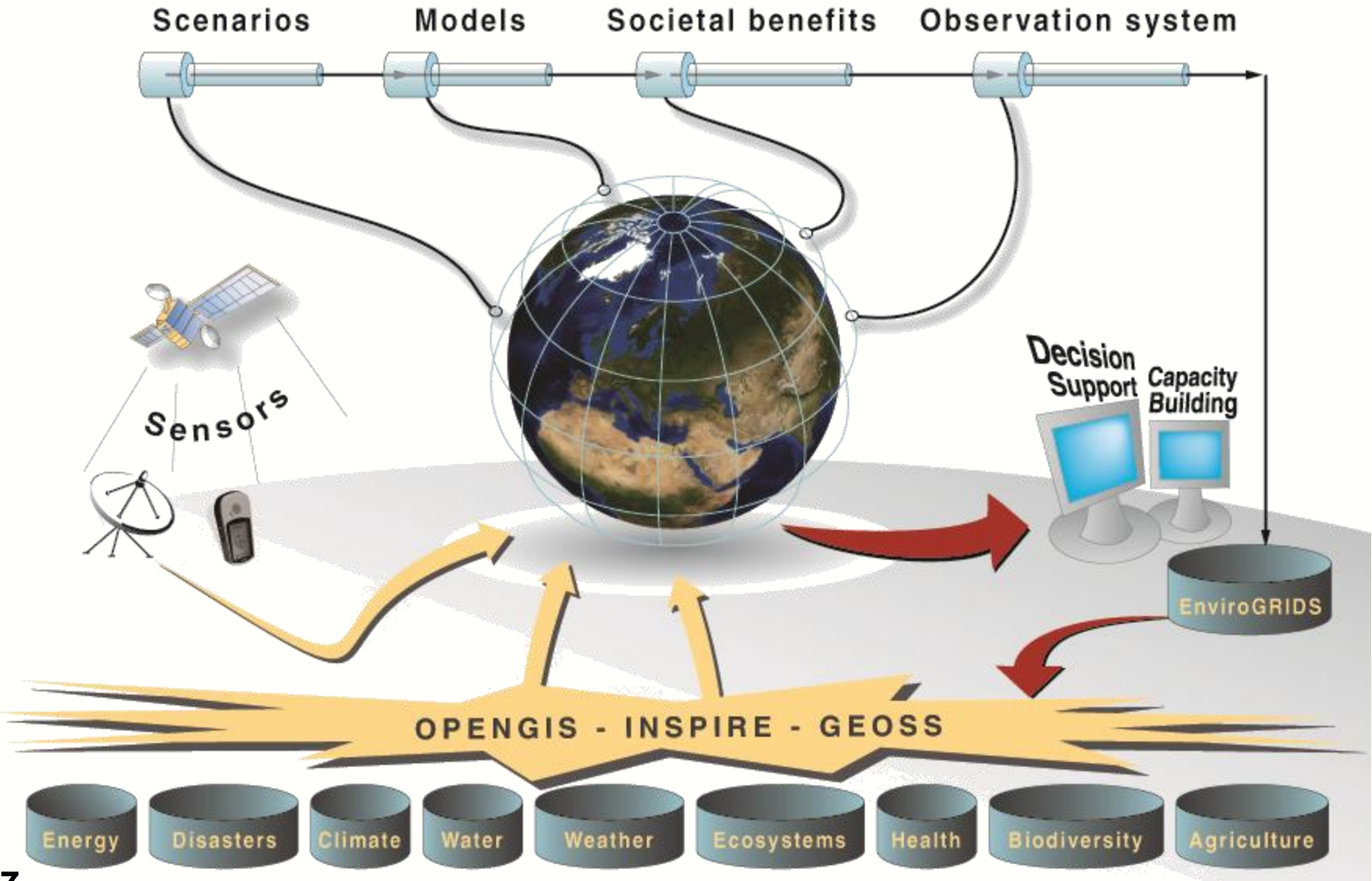


- Founded by the European Commission FP7 framework (Theme 6: environment), April 2009 – March 2013
27 partners, 7.9 mil EUR.



- Coordinator
 - University of Geneva, Switzerland

enviroGRIDS Project



Building Capacity for a Black Sea Basin Observation and Assessment System supporting Sustainable Development



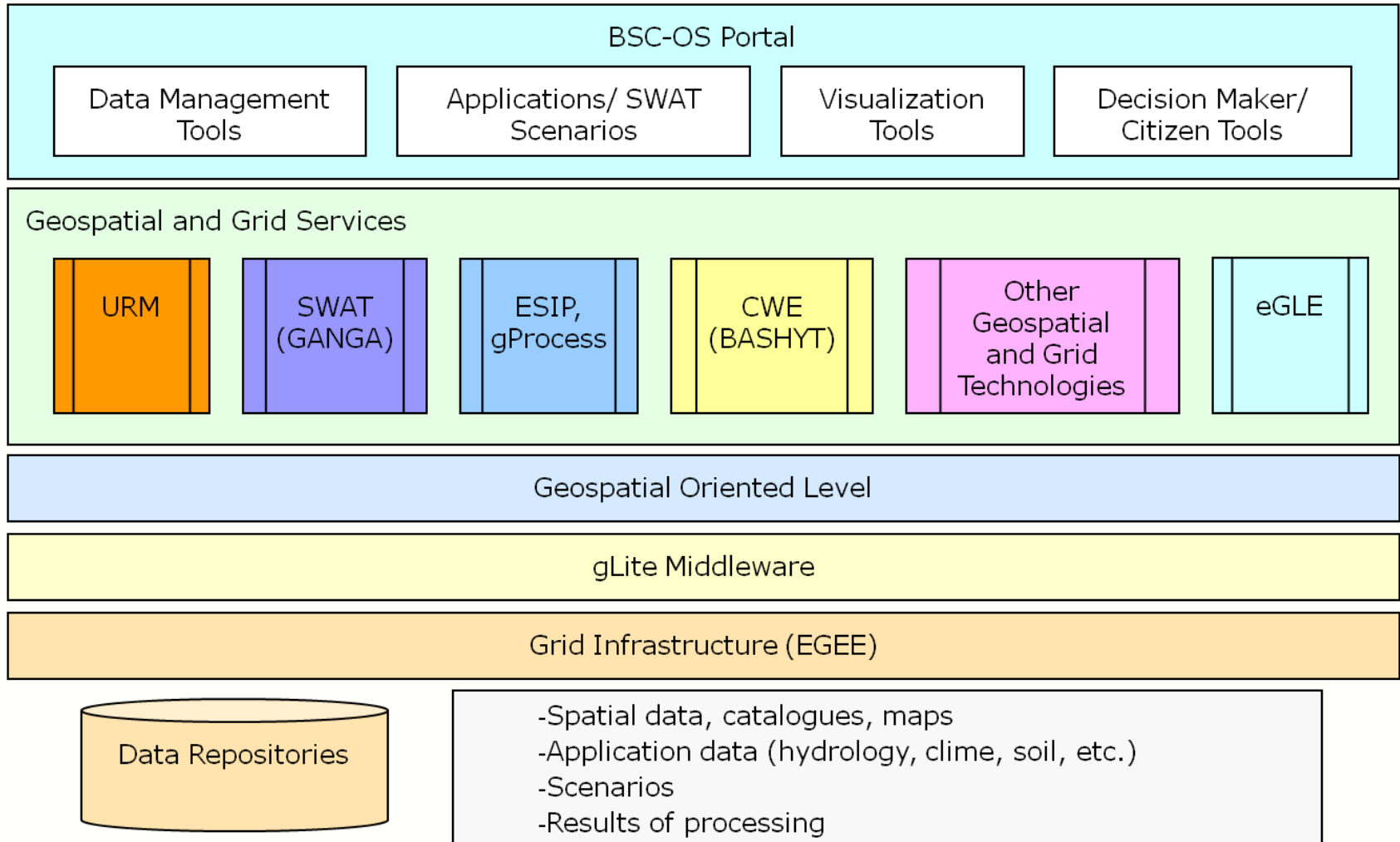
enviroGRIDS – General Objectives

- Gap analysis
- Spatially explicit regional scenarios of development
- Modeling of large scale, high resolution distributed hydrologic processes
- Develop access to real time data from sensors and satellites
- Streamlining the production of indicators on sustainability and vulnerability of societal benefits
- Develop early warning and decision support tools at regional, national and local levels
- Build capacities in the implementation of many new standards and frameworks

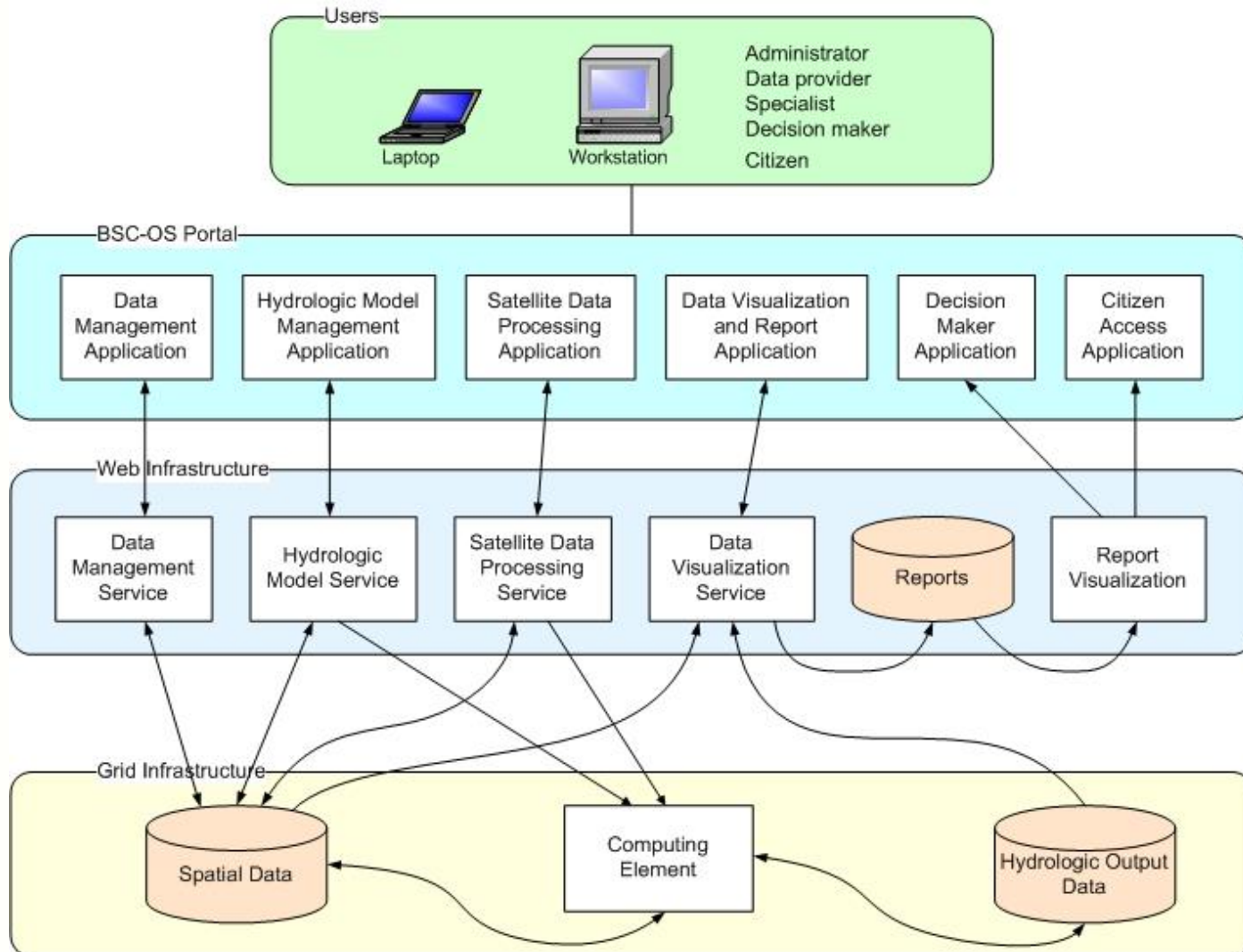
BSC-OS Portal

- Single way of the user to get into the enviroGRIDS system
- Exposes personalized tools for different category of users: data manager, earth science specialist, decision maker, citizen, and system administrator.
- Provide applications for:
 - data management
 - hydrologic models calibration and execution
 - satellite image processing
 - report generation and visualization
 - virtual training center
- Support interoperability between the Geospatial and Grid infrastructures on security, heterogeneous data access, distributed data processing
- EnviroGRIDS functionality gathers services provided by various technologies such as SWAT related modules, Collaborative Working Environment (CWE), Uniform Resource Management (URM), gProcess, ESIP, and eGLE platforms

Portal Architecture



Data Flow Throughout the Portal

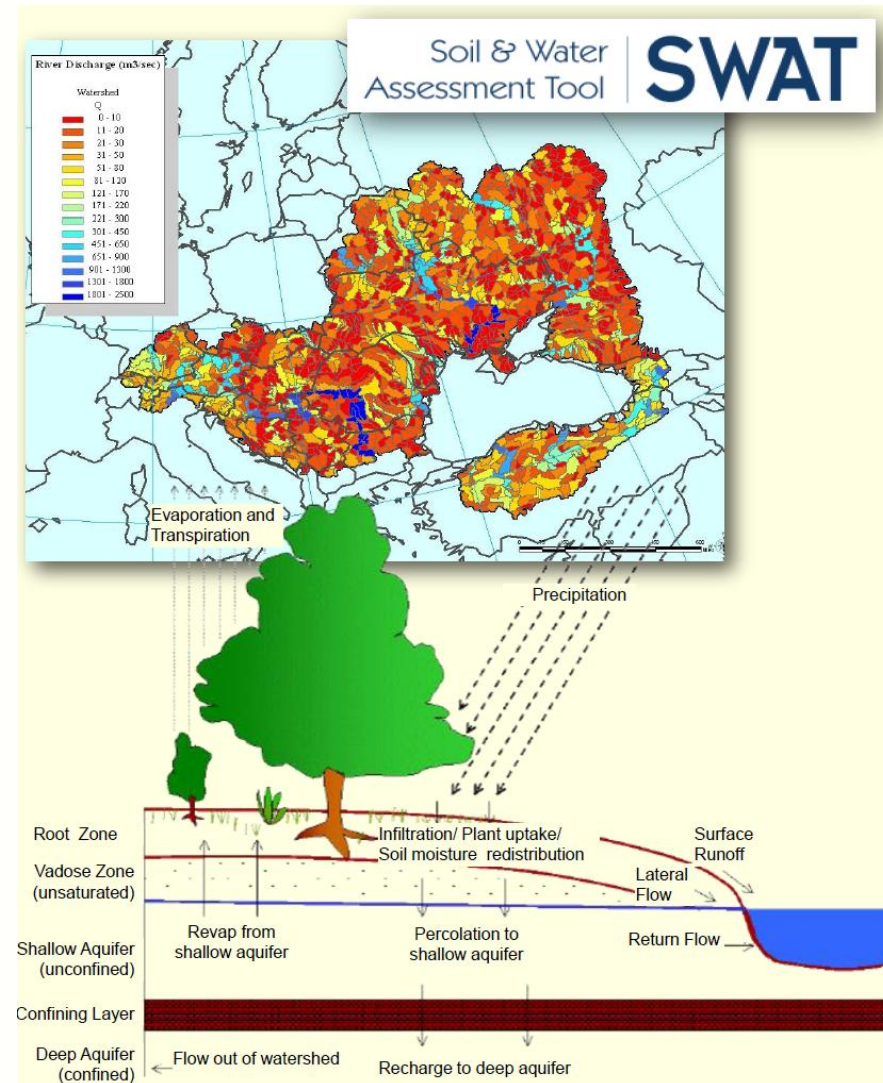


Specific Objectives

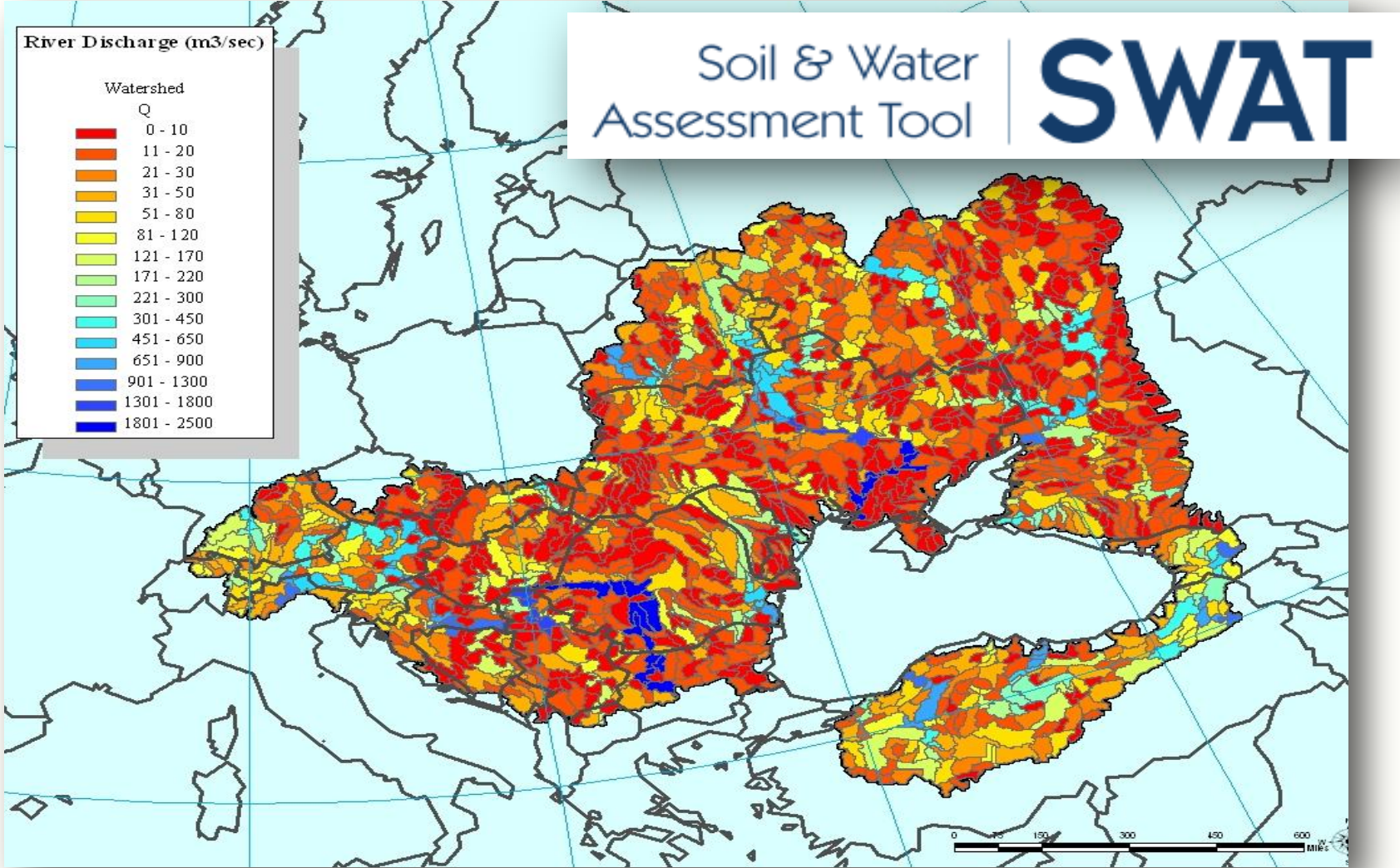
- Link, gather, store, manage and distribute key environmental data concerning the Black Sea Catchment Basin
- Large scale and high resolution distributed hydrological models
- Gridification of tools and applications
- Model and process huge spatial data over the Grid (e.g. hydrological models, satellite images, and maps)
- Develop early warning and decision support tools at regional, national and local levels

Hydrological Models - SWAT

- SWAT (Soil Water Assessment Tool)
 - hydrological model
 - operates on a daily time step
 - used for predicting the water resources, sediment, and chemical yields in a specific watershed
- Input data: weather, soil properties, topography, vegetation, and land management practices of the watershed
- SWAT estimates the impact of land management practices on water quantity and quality in complex watersheds
- The SWAT model must pass through a careful calibration and uncertainty analysis



Black Sea Catchment Basin



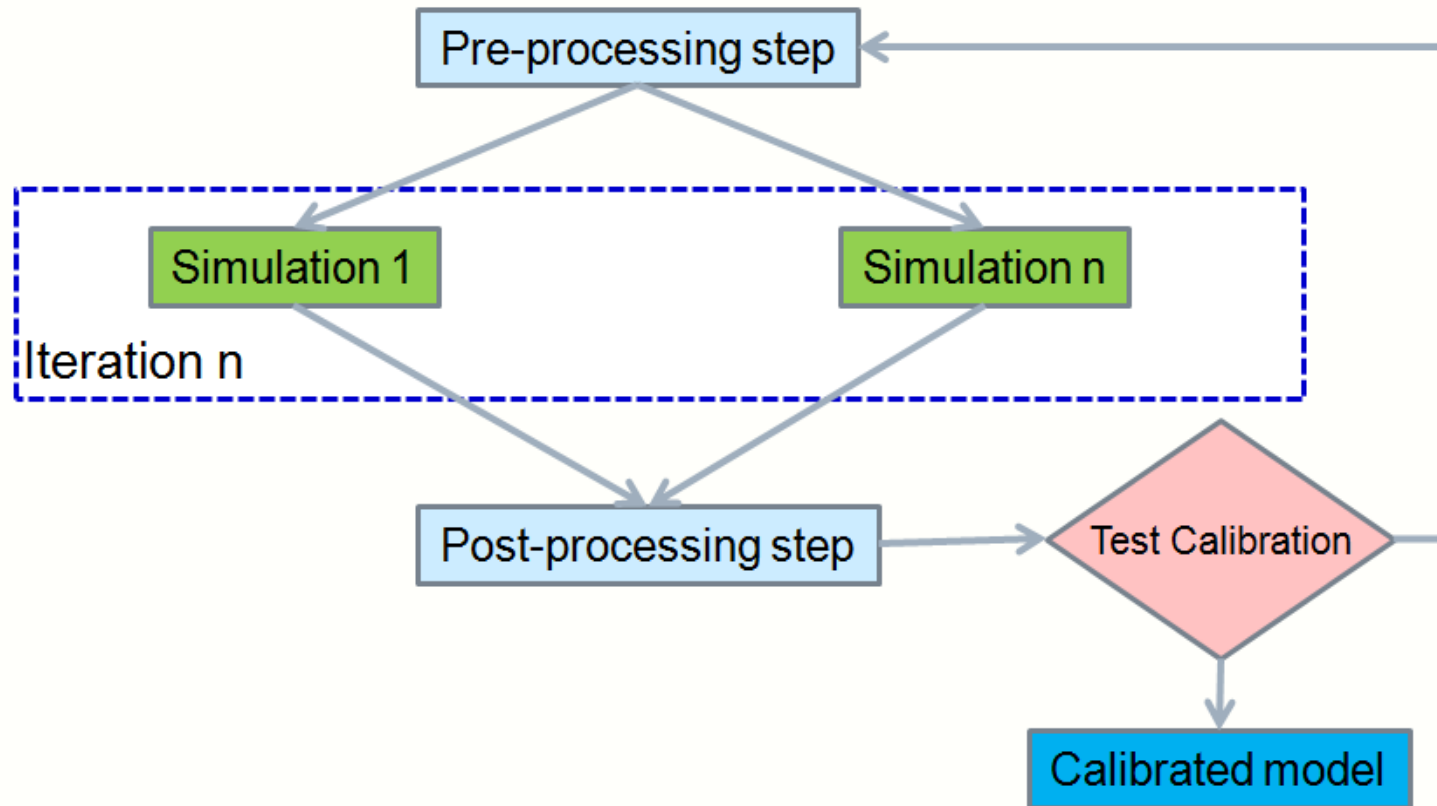
Grid Based Processing

- Many input data required by the SWAT model -> store the data on Storage Elements
- The calibration process requires running a high number of iterations, each iteration consisting in a high number of simulations -> execution on different Grid Worker Nodes
- Allows the calibration of the SWAT models and the execution of different scenarios based on a calibrated SWAT model on GRID infrastructures

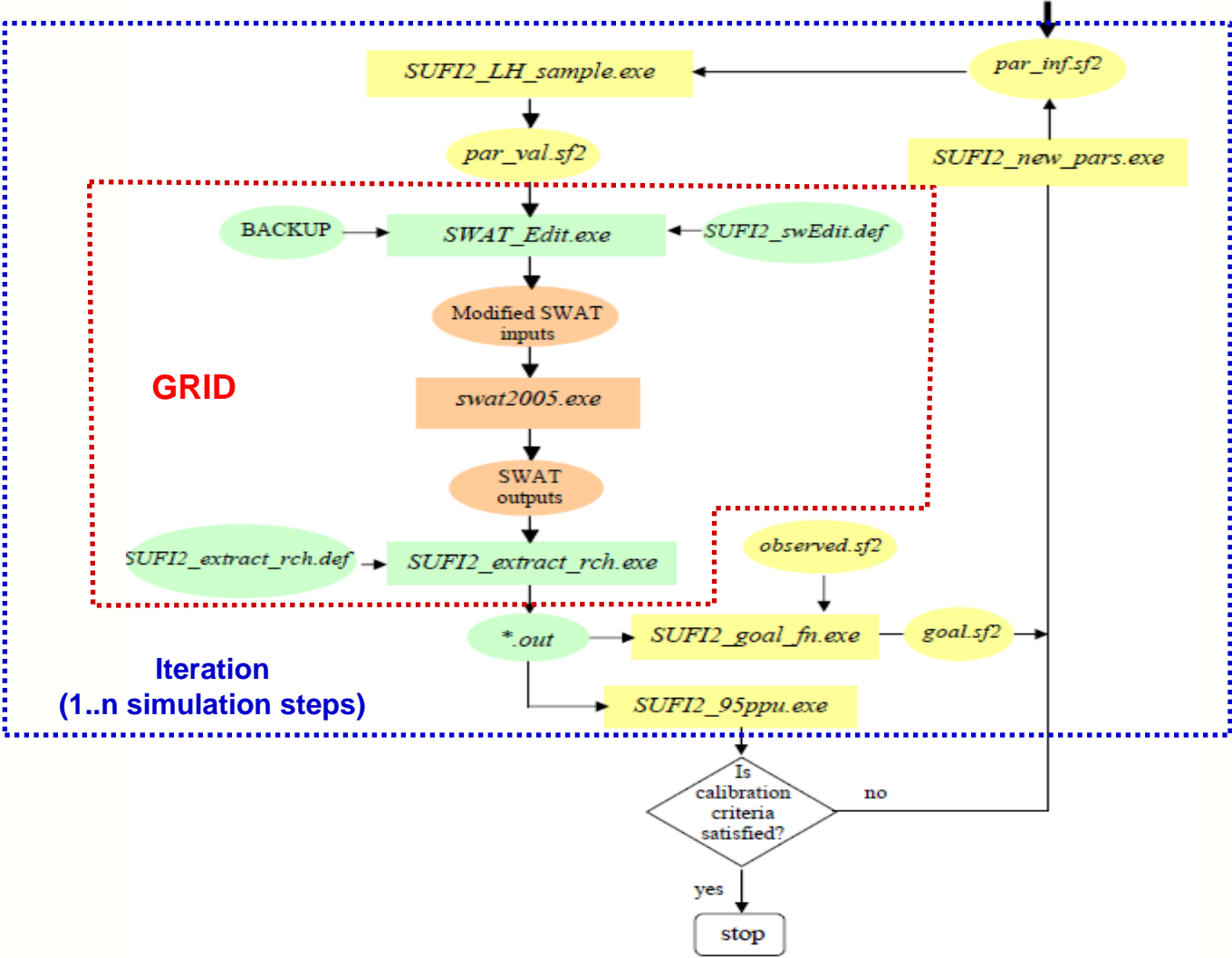
gSWAT Application

- Support the SWAT model development in the BSC-OS Portal
- Model calibration and execution over the Grid infrastructure
- Project management of the hydrological model
- SWAT data visualization
- Project upload and download
- Support interaction with visualization tools
- Support interaction with scenarios development tools

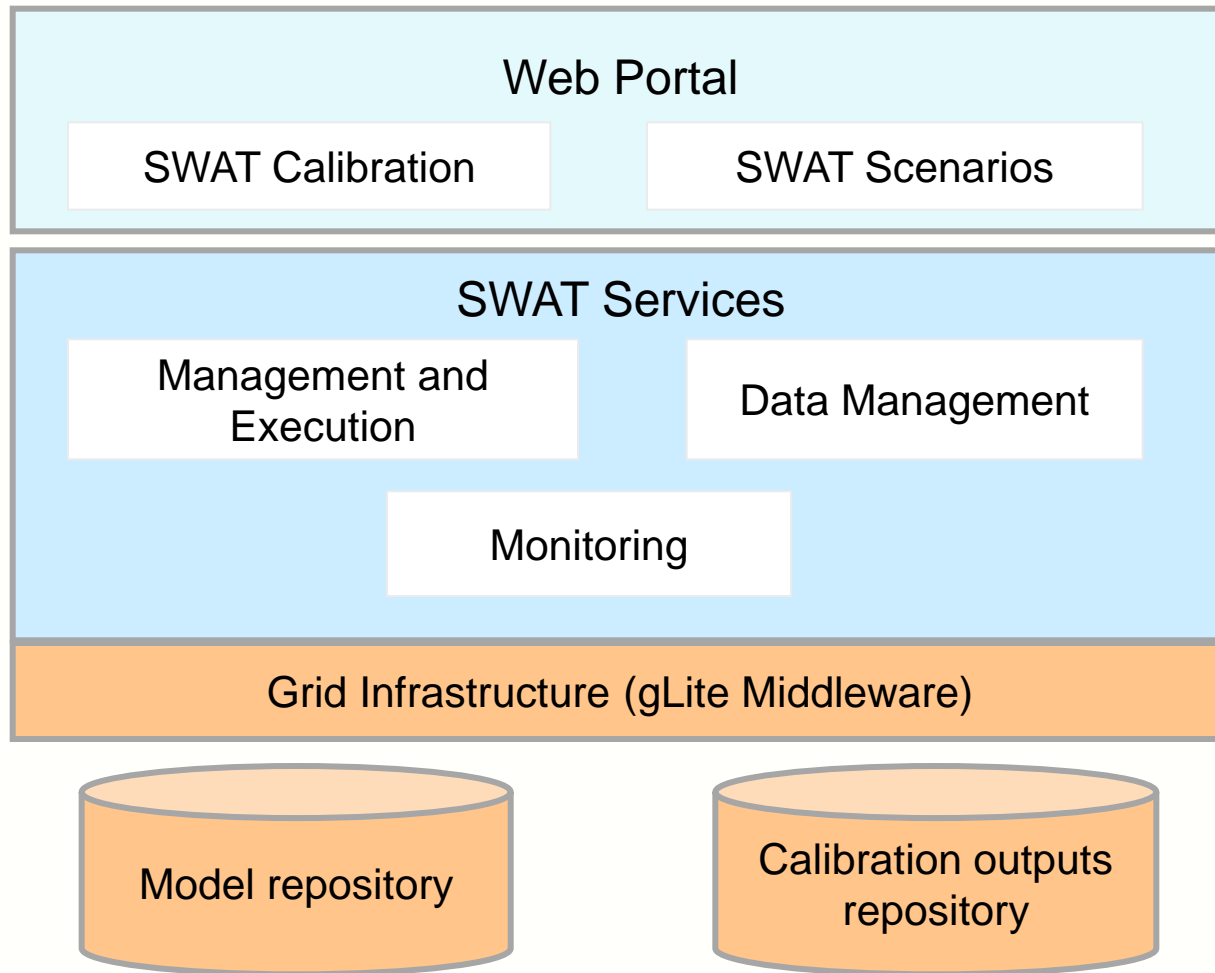
Processing Steps



Calibration Process



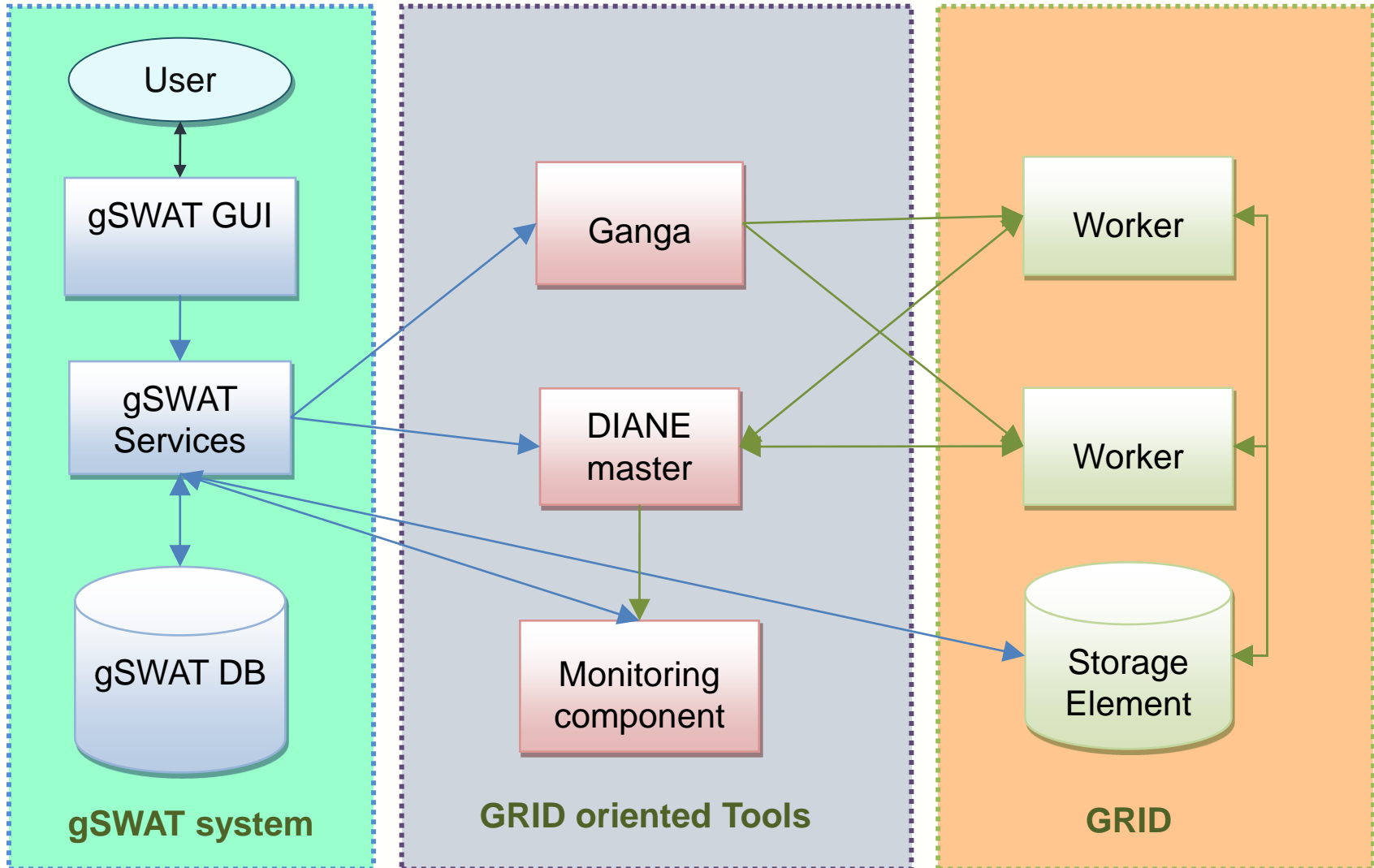
gSWAT Application - Architecture



gSWAT Execution Flow

- **Create the job script** – the executable that will run on the Grid;
- **Create the DIANE script** –specifies the input data for each task (simulation). Each task will execute one simulation. DIANE will copy the input data on the worker node prior the start of the task executable;
- **Start the DIANE master** – for each iteration we start a new DIANE master;
- **Start the Grid workers using GANGA** – the workers will connect to DIANE master to receive the tasks to be processed;
- **Monitor the execution of the tasks (simulations)** – the monitoring data is retrieved and stored on the gSWAT database from where it can be visualized by the user;
- **Download the output data** – after all the tasks (simulations) are performed the output data is retrieved and stored locally at the gSWAT server side.


gSWAT Control Flow



gSWAT User Interface


- Project list and detailed information on the selected project

Projects List

Project0
Created at: Sat Jan 29 20:21:57 GMT+0200 2011
Status: Uploading project 

Project1
Created at: Sat Jan 29 20:21:57 GMT+0200 2011
Status: Incomplete uploading

Project2
Created at: Sat Jan 29 20:21:57 GMT+0200 2011
Status: Loaded project

Project3
Created at: Sat Jan 29 20:21:57 GMT+0200 2011
Status: Running iteration 

Project4
Created at: Sat Jan 29 20:21:57 GMT+0200 2011
Status: Finished iteration

Name: Project4


Created at: Sat Jan 29 20:21:57 GMT+0200 2011

Executing since: Sat Jan 29 20:21:57 GMT+0200 2011 (13min ago)

Status: SWAT model calibration ended successfully

ArcSwat model: ArcSwat 2009

Description:

[Output results:](#) 

Modify SUFI2 Calibration Parameters

enviroGRIDS test victor 1 - gSWAT Calibration

Start calibration Save iteration Delete iteration Save Save all Close tabs Project logs Close project

Project status: Finished iteration

Project Explorer

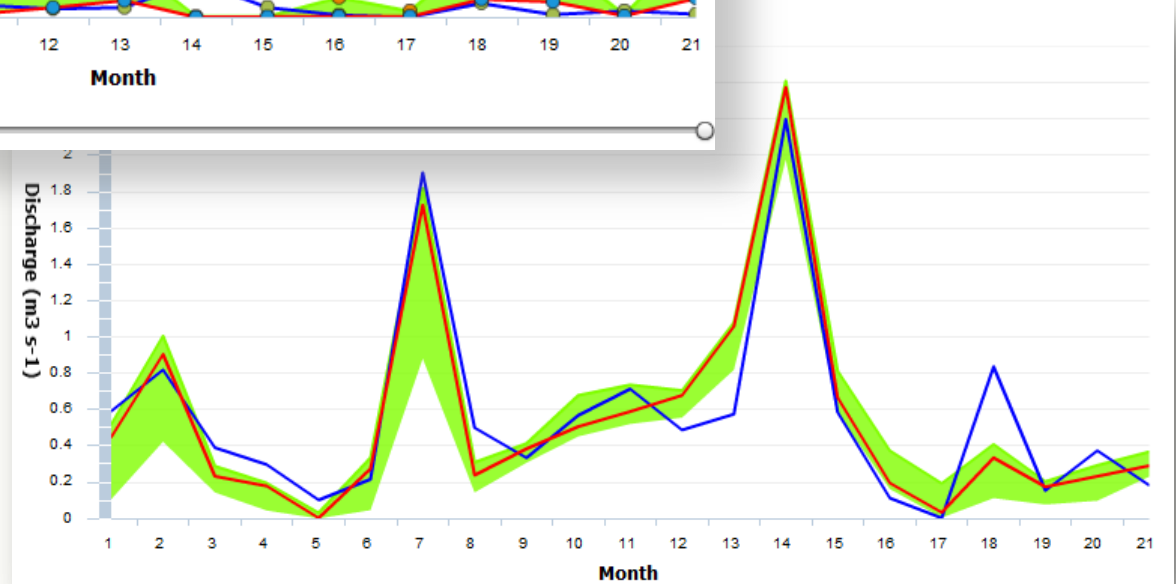
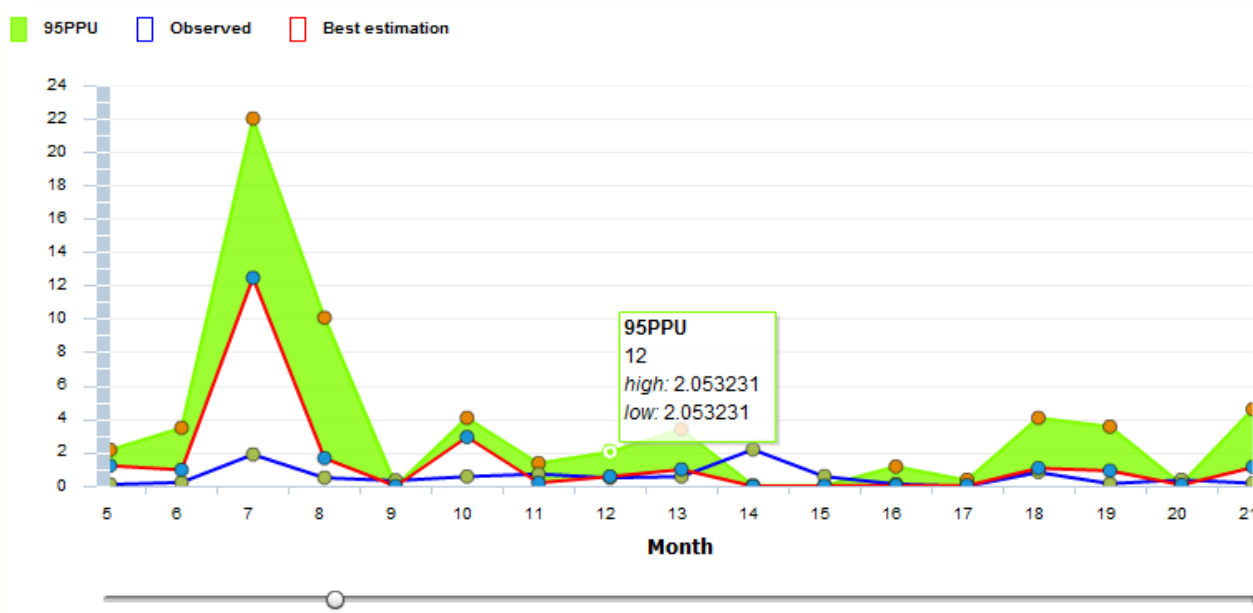
- Executable Files
- Iterations history
- Calibration Inputs
 - file.cio
 - observed.sf2
 - str.sf2
 - trk.sf2
 - var_file_rch.sf2
 - par_inf.sf2**
 - par_val.sf2
- Calibration Outputs
 - goal.sf2
 - new_pars.sf2
 - best_sim.sf2
 - 95ppu.sf2

par_inf.st

```

1 Test_example_2005
2
3
4
5 Number_of_Parameters= 10
6
7 Number_of_LH_sims= 15
8
9
10
11
12
13 r_CN2.mgt -0.1 0.1
14
15 v__ALPHA_BF.gw 0.0 0.08
16
17 v__GW_DELAY.gw 34 45
18
19 v__CH_N2.rte 0.0 0.08
20
21 v__CH_K2.rte 5 13
22
23 v__ALPHA_BNK.rte 0 1
24
25 r__SOL_AWC(1).sol 0.02 0.4
  
```


Calibration Output Visualization





SEE-GRID-SCI
SEE-GRID infrastructure for regional eScience

- **ESIP** - Environment Oriented Satellite Image Processing Platform

ESIP has been approved for endorsement by the **EGEE RESPECT Program**. The RESPECT program (Recommended External Software for EGEE Communities) aims to publicize grid software and services that work well in concert with the EGEE gLite software.

ESIP demo is available at

<http://cgis.utcluj.ro/movie/ESIP.wmv>

- based on the gProcess platform developed by the **MedioGrid** project.
- The **gProcess** toolset supports the flexible description, instantiation, scheduling and execution of the Grid processing.
- gProcess has been extended and ESIP developed through the SEE-GRID-SCI Project.

- The **gProcess** platform is a collection of Grid services and tools providing the following basic functionality:
 - Interactive description of the Grid based satellite image processing by pattern workflow
 - Development of hyper-graphs as a composition of basic operators, services, and sub-graphs
 - Pattern workflow instantiation for particular satellite image
 - Satellite data management, access and visualization
 - Workflow based Grid execution
- Wiki description of ESIP:
 - http://wiki.egee-see.org/index.php/JRA1_Commonalities

gProcess and ESIP Platforms

- **ESIP Platform** development, and Methodological Approach for **ESIP** based application development

Partners: 1. Technical University of Cluj-Napoca (UTCN), ESIP coordinator
2. National Center for Information Technology (NCIT) Bucharest
3. West University of Timisoara (UVT)
4. ICI Bucharest, national coordinator

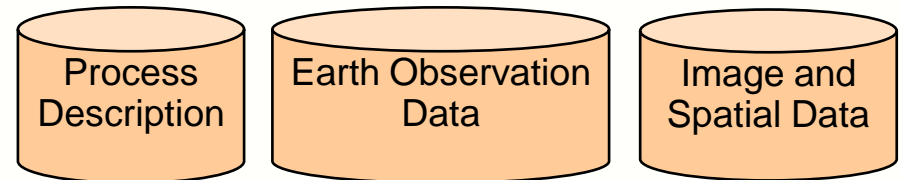
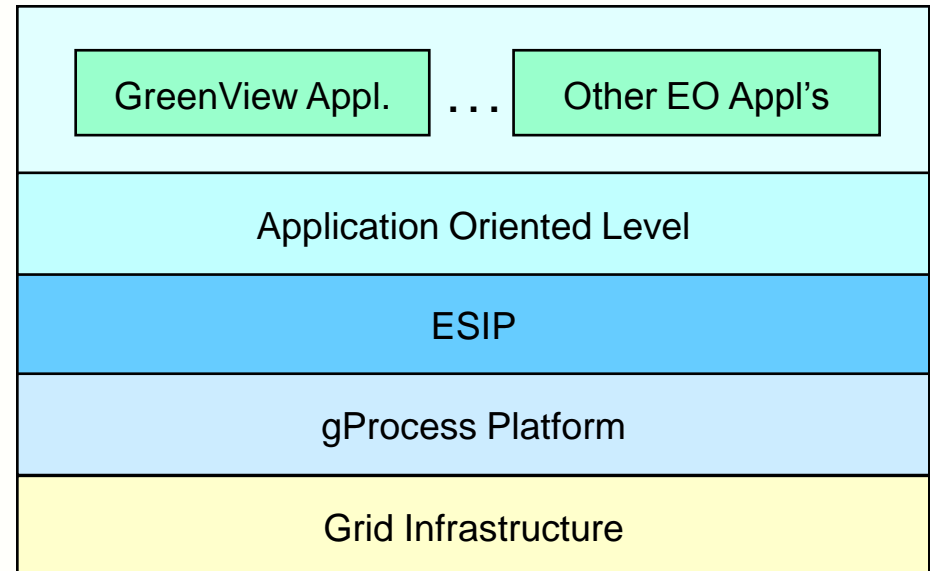
- **gProcess** and **ESIP** have been used to develop the **GreenView** application

- User Communities

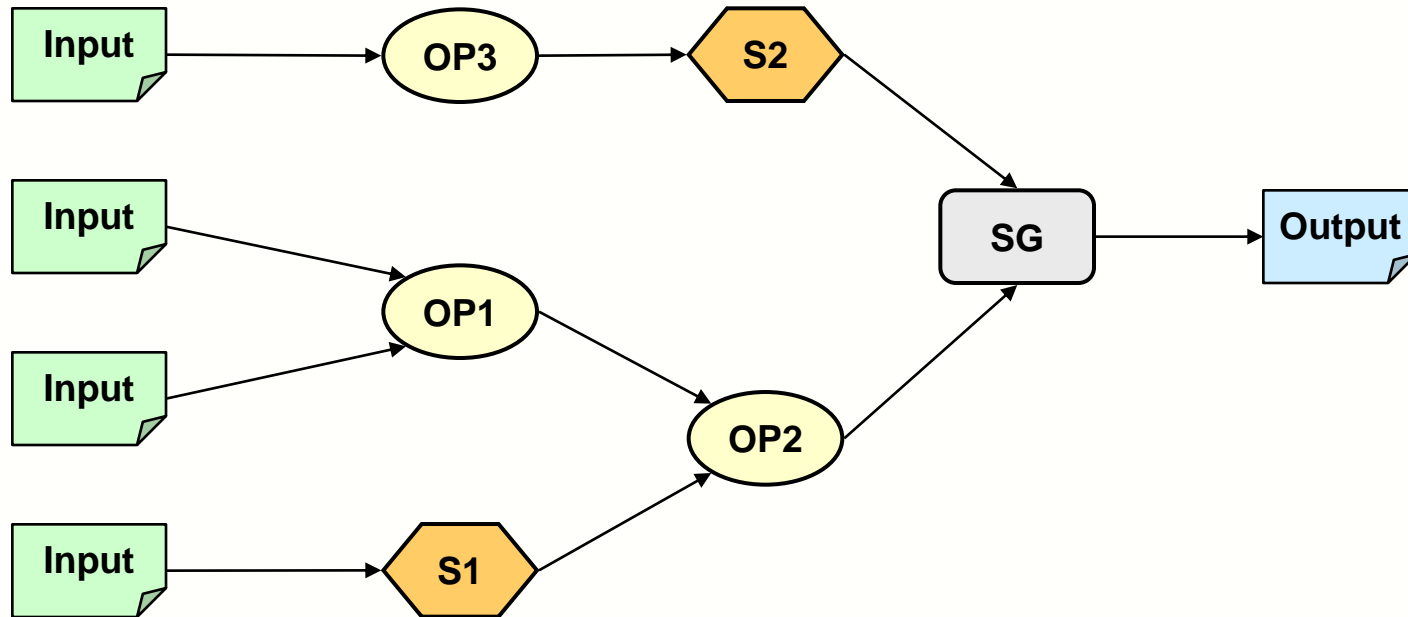
The main beneficiaries of this VO are Government Organizations, Environment Agencies, Hydrological Institutes, and Research Groups involved in environment supervision and behavior prediction of natural phenomena, especially in vegetation related studies

gProcess and ESIP Functional Levels

- Grid Infrastructure
 - access to computational nodes, data, security
- gProcess Platform
 - set of services used for the management and the execution of iPDGs
- ESIP Platform
 - set of operators and services used in satellite image processing
- Earth Observation application
 - integrates all the features into a complex application



Hypergraphs – Process Description Graph



The hypergraph is a complex graph that combines operators (OP), services (S) and subgraphs (SG). The subgraph could be a simple or complex graph.

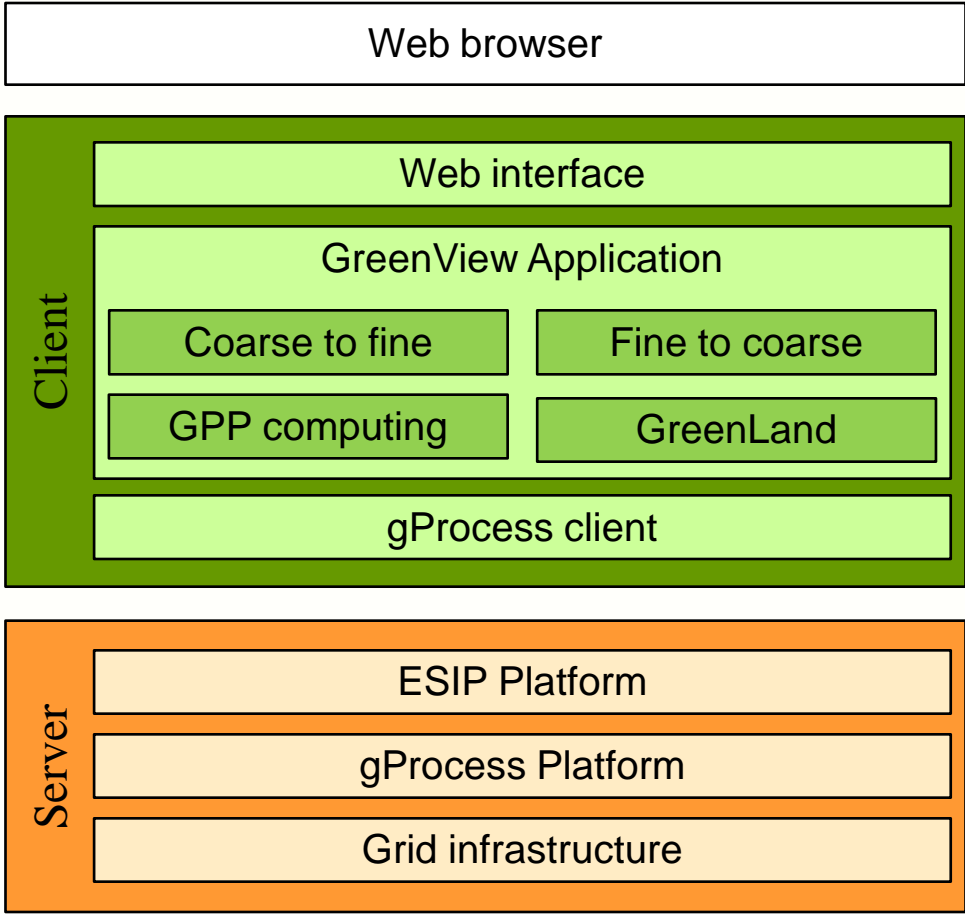
Inputs: Spectral bands in satellite images – MODIS, Landsat, QuickBird, etc

OP examples: Add, Subtract, Blur, Sharpen, EdgeDetection, HistogramEq, PseudoColoring, Erosion, etc.



- **GreenView** is an environmental application used for predicting and monitoring the temperature over a specific geographical area. Classify the satellite images based on the computation of the vegetation indices. Actually it experiments the computation just for CEE regions. The functionality could be extended to other geographical areas.
- Demo is available at (sound on):
<http://cgis.utcluj.ro/movie/GreenView.wmv>
- GreenView application is developing through the SEE-GRID-SCI Project (FP7), by the following partners:
 1. Technical University of Cluj-Napoca (**UTCN**), Politehnica University of Bucharest (**NCIT**), West University of Timisoara (**UVT**), and National Research Institute for Informatics (**ICI**)
 2. Eötvös Loránd University (**ELU**) from Budapest (Hungary)
 3. Research and Educational Networking Association of Moldova (**RENAM**)

GreenView Architecture



Coarse to Fine Interpolation – GUI Sample

Coarse to fin
Fine to coarse
Gpp computing
GreenLand
Processing status
User options
About GreenView

Geographical region selection

Select subarea from the HDF region
 Apply interpolation on the entire HDF region

Select area by value Select area by mouse

Lat Long

A (48.65128 , 16.83765)

Geographical area

B (44.29657 , 25.36304)

Lat Long

{year, month}

MODIS satellite image

Temperature values

Interpolation

Pseudo-coloring

Output

Coordinates conversion























GreenView - Results

Processing information

Processing ID: 895

Last refresh: 5 September 2009, 15:00:47 (refresh every 50 seconds)

Change refresh time: 50 seconds ▼

description	Node name	Start server time	End server time	Status	Options
rezultat9.tif	33_FineToCoarse	2009-09-05 14:53:25	2009-09-05 15:03:04	DONE	 
rezultat8.tif	30_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 
rezultat7.tif	27_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 
rezultat6.tif	24_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 
rezultat4.tif	18_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 
rezultat5.tif	21_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 
rezultat3.tif	15_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 
rezultat2.tif	12_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 
rezultat1.tif	9_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 
rezultat10.tif	3_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 
rezultat0.tif	6_FineToCoarse	2009-09-05 14:53:26	2009-09-05 15:03:14	DONE	 

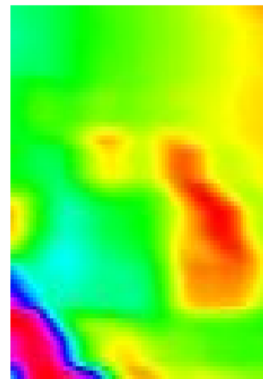
Result details for node: 27_FineToCoarse

Result file name: 6d9f073d-9353-4120-b364-56b6f51d9768/FineToCoarse_27_436.jpg

Processing start time: 2009-09-05 14:29:08

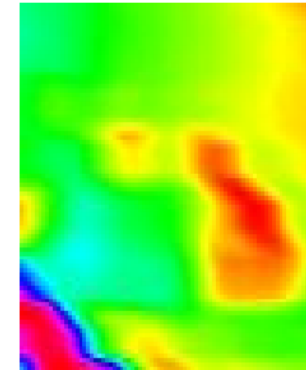
Processing end time: 2009-09-05 14:37:26

Image result for:



Slideshow: January 1961 - January 1961

Image title: 1961, January



Node name: 21_FineToCoarse

File name: 040825e4-0073-41ff-91b1-b722bdf452bc/FineToCoarse_21_435.jpg

Start processing time: 2009-09-05 14:14:11

End processing time: 2009-09-05 14:27:33

Slideshow image position: 1 / 7

<< Prev

Pause

Next >>

Waterland Application

On-line available Web application: <http://greenland.mediogrid.utcluj.ro>

1

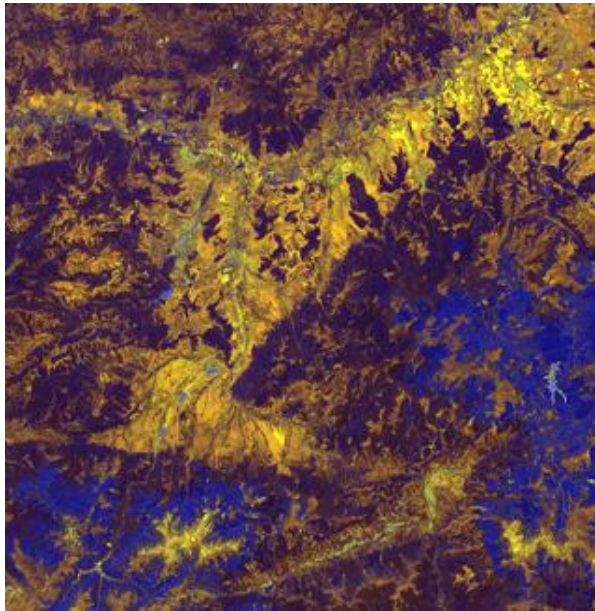
2

3

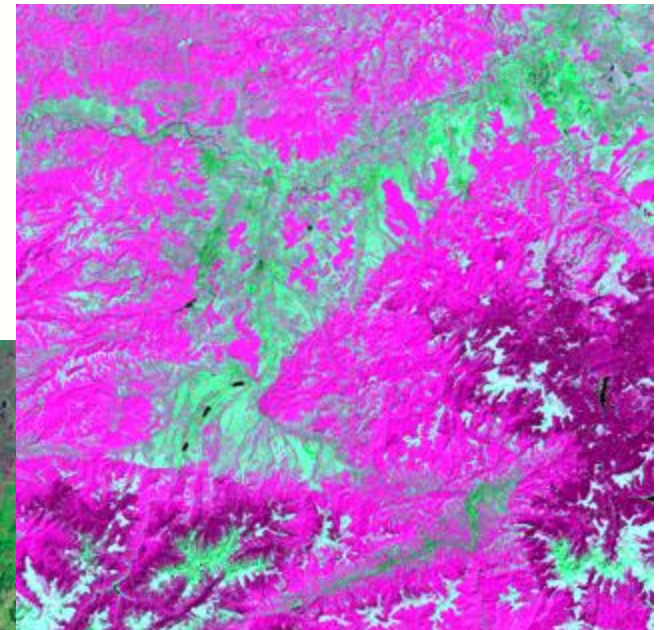
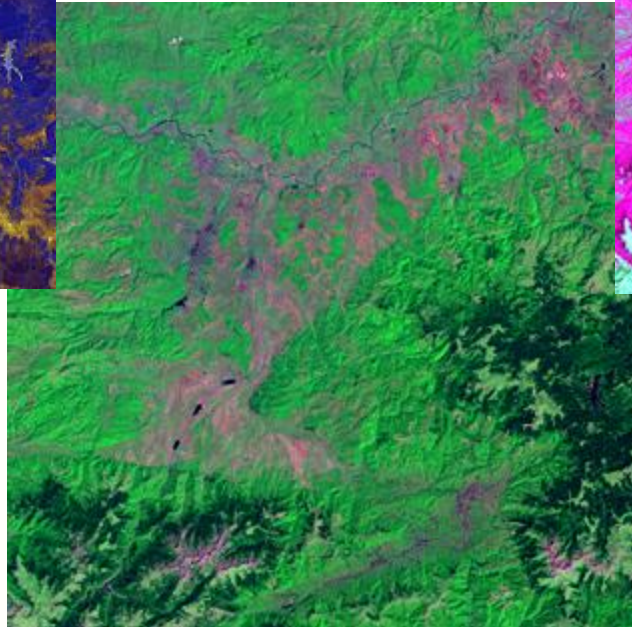
4

ImageId	Image Name	StartTime	EndTime	Status	View Result
1	romania1	Sat Jun 09 18:21:31 EEST 2007	null	Pending	view
2	romania2	Sat Jun 09 18:21:31 EEST 2007	null	Pending	view
3	romania3	Sat Jun 09 18:21:31 EEST 2007	null	Pending	view
4	romania5	Sat Jun 09 18:21:31 EEST 2007	null	Pending	view

Minerals Application



Hydrothermally-altered areas.



Iron-oxides and hydroxyl-bearing minerals.

The Metaliferi Mountains area presented as a false color image (Band 7 by red, band 4 by green and band 2 by blue).



- **eGLE (GiSHEO eLearning Environment)**
application is developing through the GiSHEO Project.
- **GiSHEO** - On Demand Grid Services for Higher Education and Training in Earth Observation (<http://gisheo.info.uvt.ro>)
- Supported by ESA PECS Program (<http://pecs.esa.int/>) for the period of 2008-2010
- Demo available at (sound on):
<http://cgis.utcluj.ro/movie/eGLE.wmv>

Research team (Romania):

1. West University of Timisoara (UVT)
2. Technical University of Cluj-Napoca (UTCN)
3. Romanian Space Agency (ROSA)
4. National Institute for Space Research (INCAS)

General Objectives in GiSHEO and eGLE

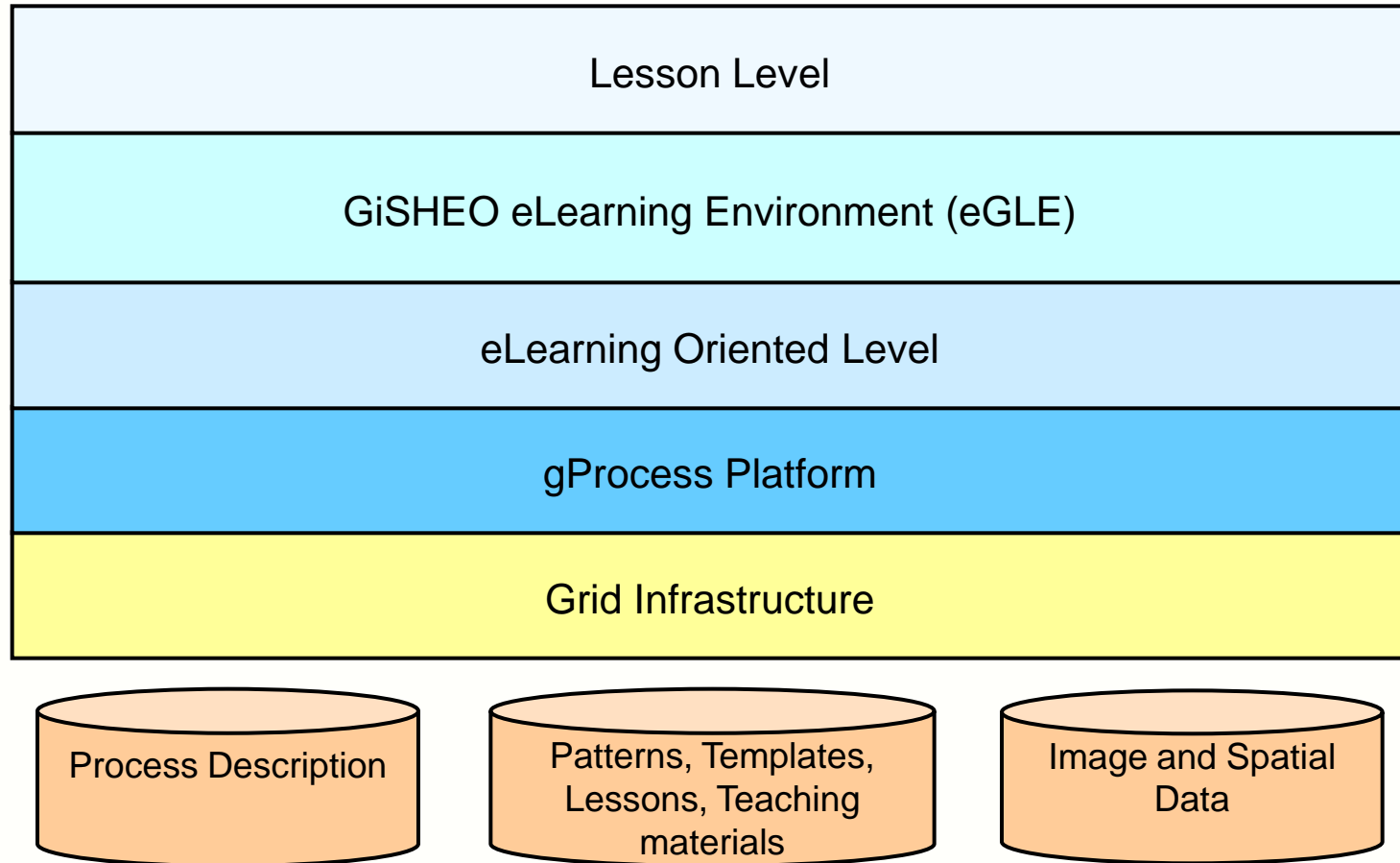
- Study the requirements and specifications for distance learning in Earth Observation training
 - User requirements (i.e. professor, students), eLearning environment functional specifications, usability requirements, lesson structure, user interaction techniques.

- Tools development over GRID Technology to enable the creation and the execution of lessons for Earth Observation
 - Create specialized tools that take advantage of GRID capabilities in a transparent manner for the user (student or teacher) in order to allow the processing of massive data.

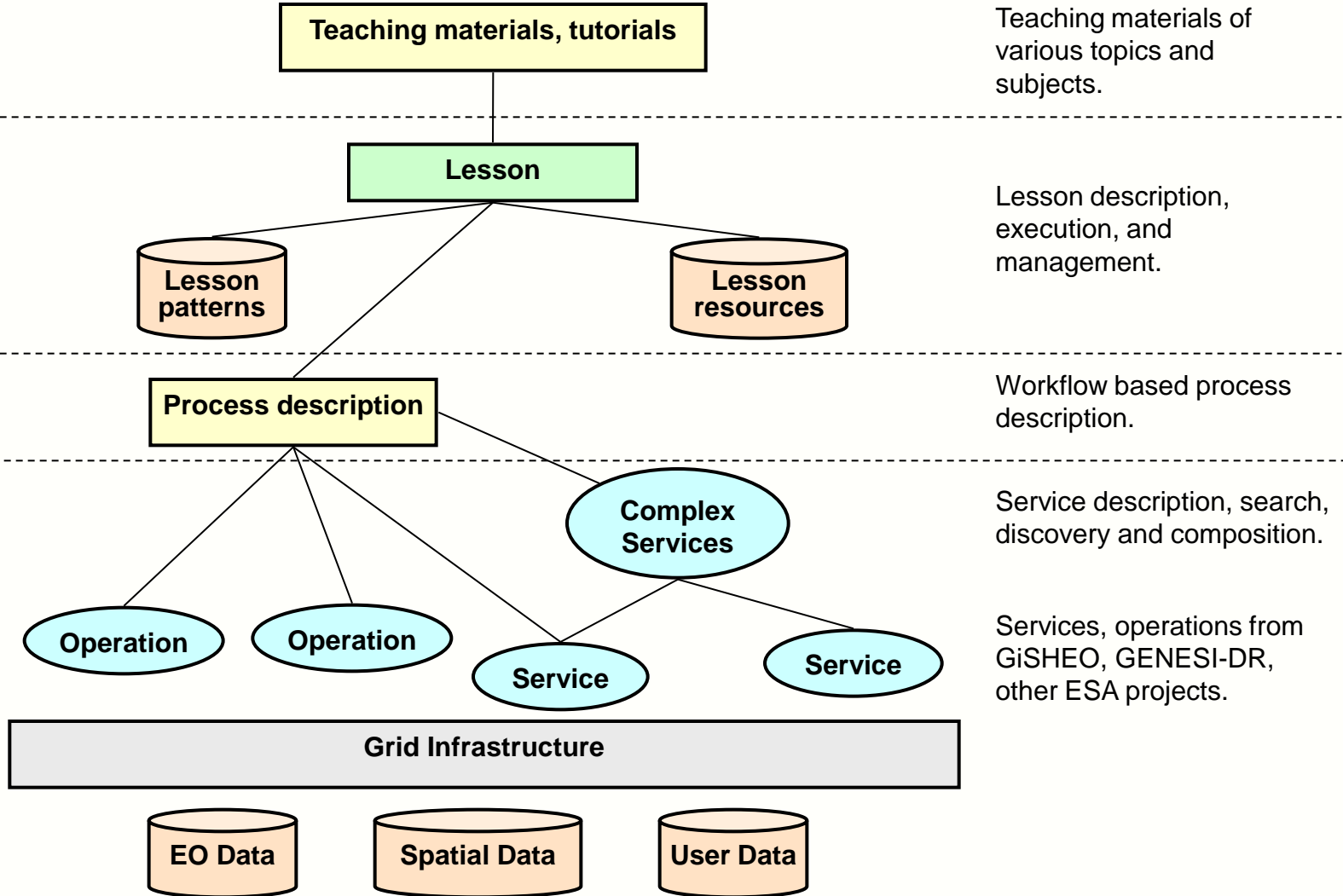
- Creation of lessons templates in order to allow non-technical teachers to create lessons for Earth Observation
 - Create templates that allow teachers specialized in Earth Observation, but with non-technical studies, to develop new lessons by using GRID advantages and large amounts of data (satellite images).

- Use Earth Observation data and services provided by GENESI-DR.
 - Explore and experiment data availability and accessibility to GENESI-DR from remote Grid applications in terms of: accessing policies, types, formats, services, data replication, transfer performance, granularity, consistency, and efficiency

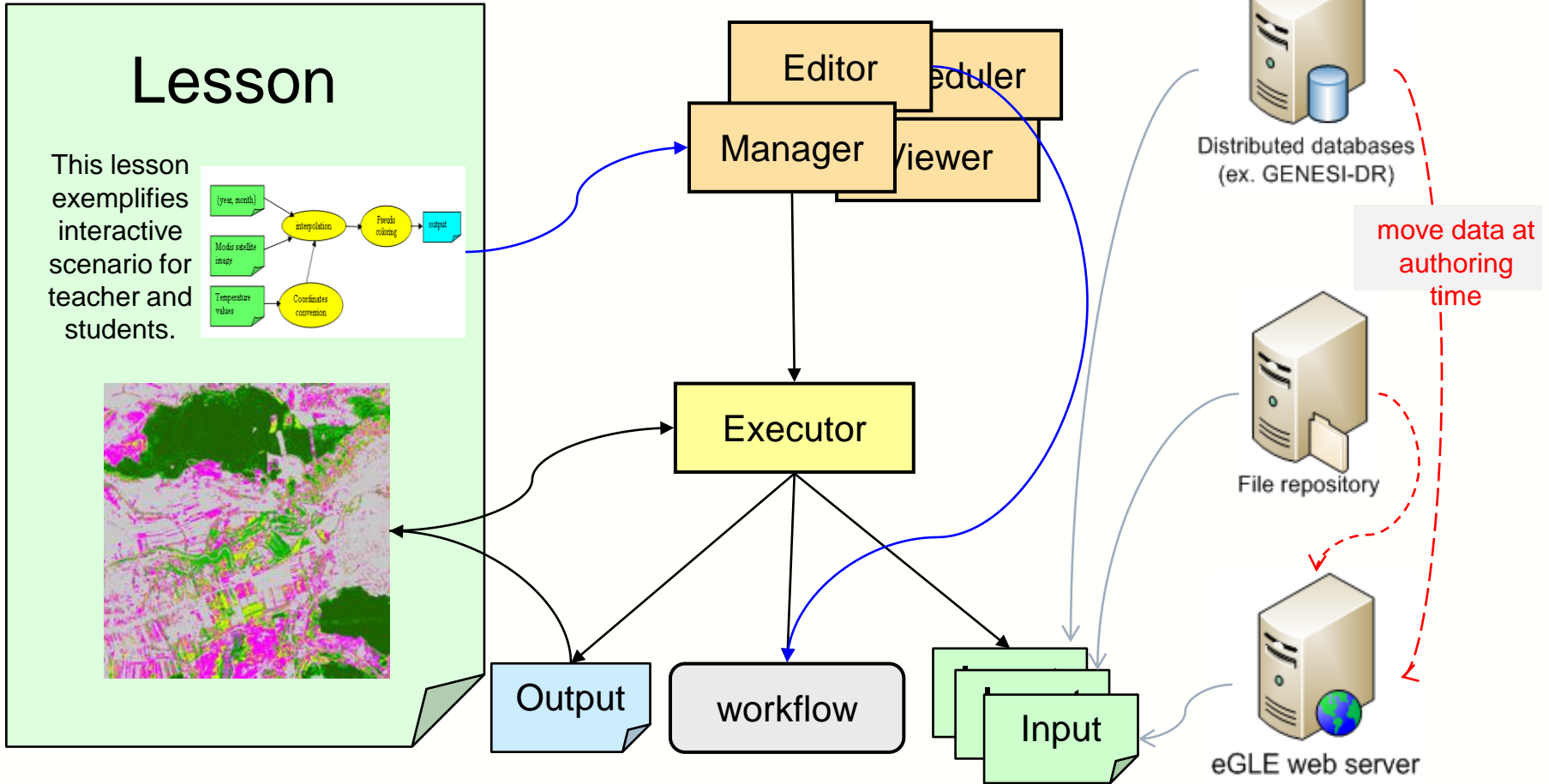
Functional Levels in eGLE Architecture



eGLE - Data and Process Flow



Grid Based Execution of Env. Scenarios



eGLE Tools

The screenshot displays the eGLE Tools interface with several components:

- Workflow Diagram:** A flowchart showing the data processing pipeline. It starts with input bands (SWIR, NIR, Red) and intermediate steps like 'NDWI Subpr...', 'NDWI Subpr...', and 'NDWI', leading to a final 'NDWI' output. A 'Subpr...' node is highlighted in red.
- Satellite Image:** A grayscale satellite image of a landscape with a river and buildings.
- Text Description:** A text box explaining the water detection algorithm:

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.
- Process Status Table:** A table titled 'Current process status information' showing the progress of various nodes.

Node name	Start server time	End server time	Status	Options
Subpr...	2025-11-19 12:28:26	2025-11-19 12:28:26	STOPPED	
NDWI	2025-11-19 12:28:26	2025-11-19 12:28:26	POWER	
NDWI	2025-11-19 12:28:26	2025-11-19 12:28:26	POWER	
NDWI	2025-11-19 12:28:26	2025-11-19 12:28:26	POWER	
- UI Elements:** A 'slideshow off' button, a toolbar with various icons, and a 'play/pause/stop' control at the bottom right.

Lesson Samples

The screenshot shows a web-based lesson management interface. On the left is a sidebar with navigation options: Users, Courses, My students, and Logout. The main content area displays a lesson titled "Hydrothermal Alteration" under the "Image Processing and Analysis" category. The lesson content is presented in a "Text only" format. The text discusses the goals of research on economic ore minerals and the geological exploration approach. A "back to lessons list" link is visible at the top left of the lesson content area.

The screenshot shows a lesson titled "Mineral Explorations by Landsat Image Ratios". It includes a "back to lessons list" link and a "Contents" section with the following items:

- Introduction
- Spectral Characteristic of Rocks and Minerals
- **Image Processing and Analysis**

The lesson content is presented in a "Text only" format. The text discusses the goals of research on economic ore minerals and the geological exploration approach. A "back to lessons list" link is visible at the top left of the lesson content area.

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].

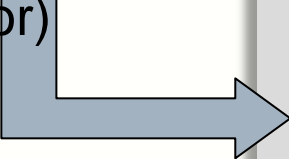
Ratio Technique Using Landsat Data

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

Lesson Samples

Runtime

Authoring (WYSIWYG editor)



Lesson Samples – GRID Oriented Tools

back to lessons list

GRID Related Tools

Contents

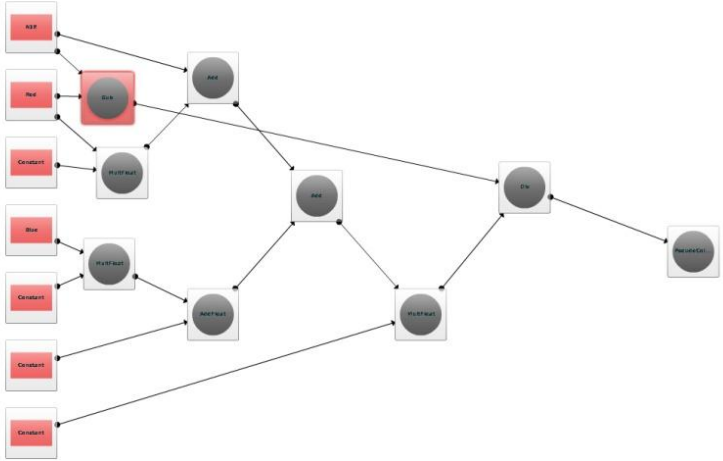
- Modul de vizualizare PDG/PDGG
- Modul de monitorizare a executiei pe GRID
- Image processing algorithms

Load EPDG Load PDG

Node details

Zoom out Zoom in

testEVI.ipdg -> EVI_Subgraph.ipdg



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GRID Related Tools

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- Modul de vizualizare PDG/PDGG
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- 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:

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

Lesson Execution Monitoring

Execution

Launch Search Interaction settings

Available IPDG:
 NDVI

Execution description:
 Perform NDVI computation on specific satellite images.

Execution title:
 Compute NDVI value

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			

Current process status information

Node name	Start server time
3_6_PseudoColoringV2	2010-04-07 02:24:26
3_5_Div	2010-04-07 02:24:26
3_4_Add	2010-04-07 02:24:27
3_3_Sub	2010-04-07 02:24:27

Execution

Launch Search Interaction settings

Processes that can be monitored by students:

Title	Description
Compute NDVI value	Perform NDVI computatio
TestGisheo	TestGisheo

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

Save these settings

Add Remove

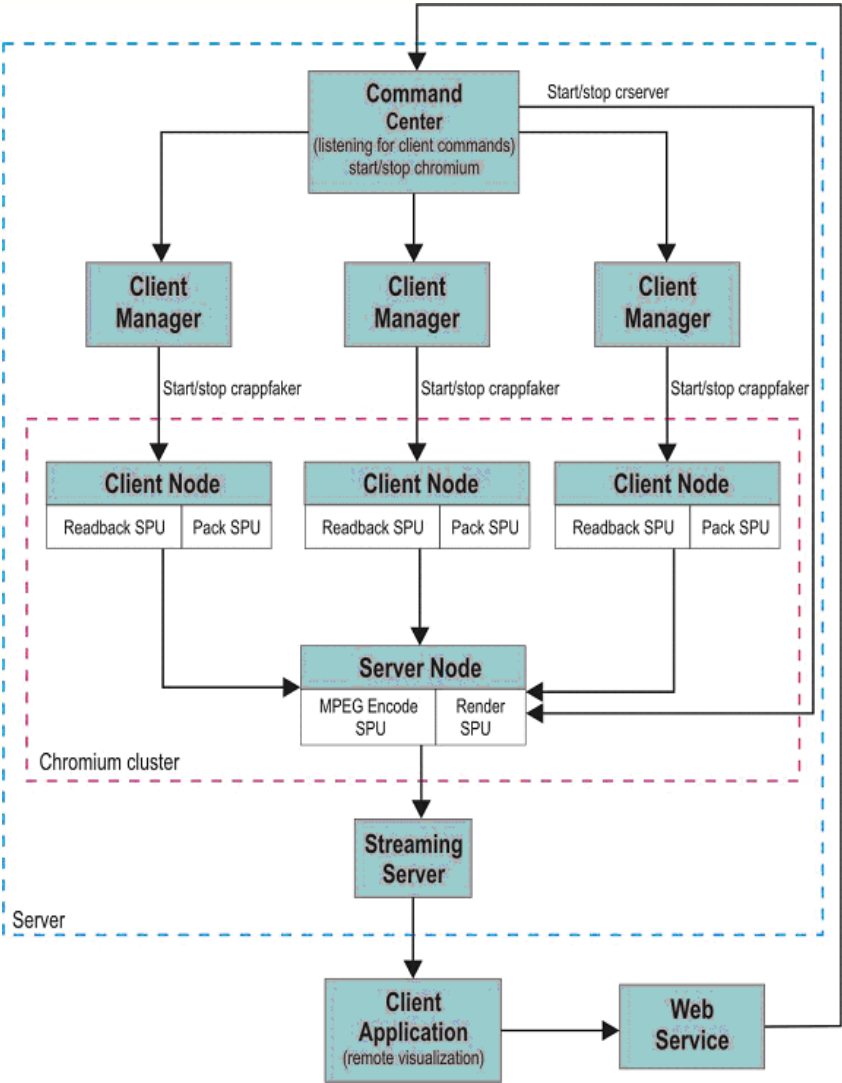
Current process status information

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	

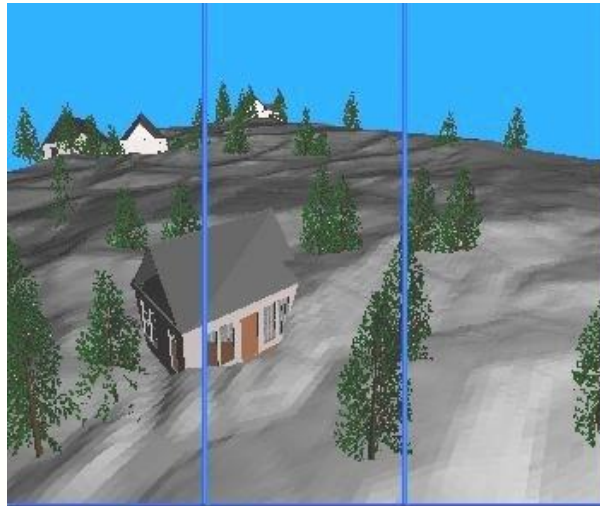
Virtual Geographical Space

- Develop a strong, intuitive language for generating visualization scenarios
- Enable parameterization of each created scenario
- Develop a desktop application that integrates the scenario language and allows the user to render in video or image file format
- Develop and test scene graph format, executable on the graphics cluster
- Test the system for execution and visualization of a 3D static or dynamic environment that is existent on graphics clusters

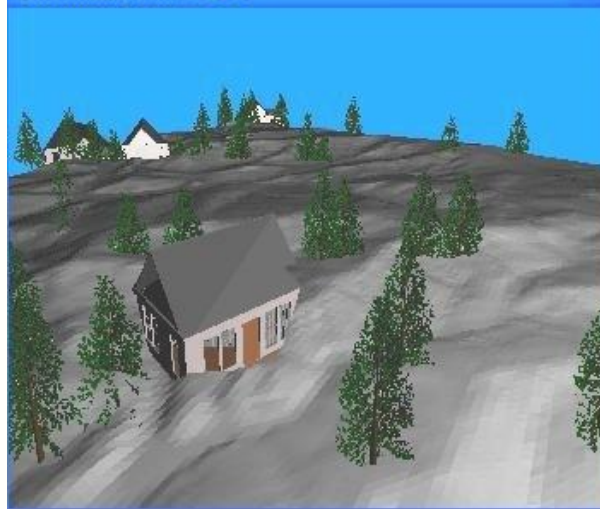
Remote Visualization Architecture



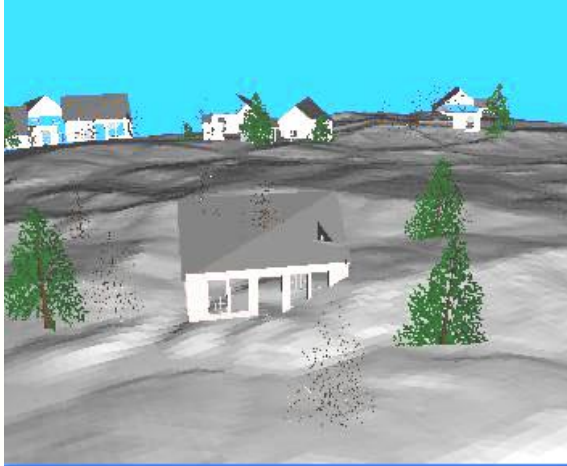
Sort-First Visualization Algorithm



Chromium Render SPU



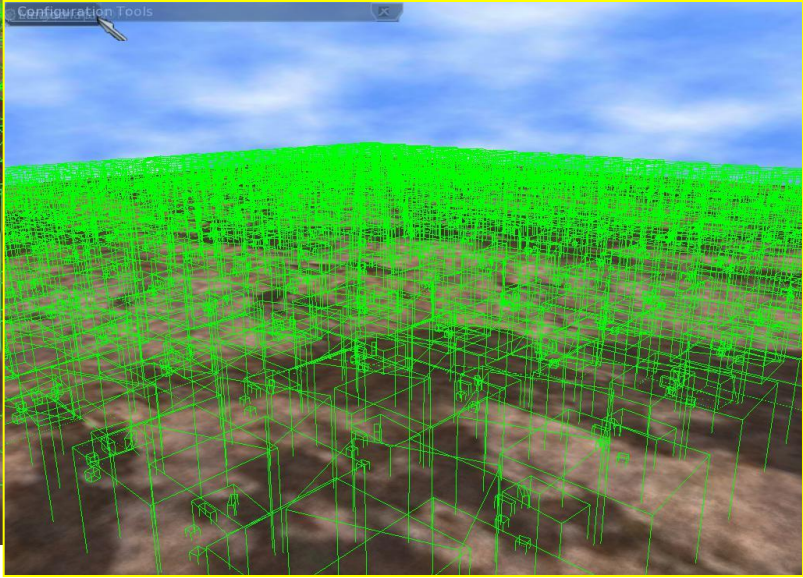
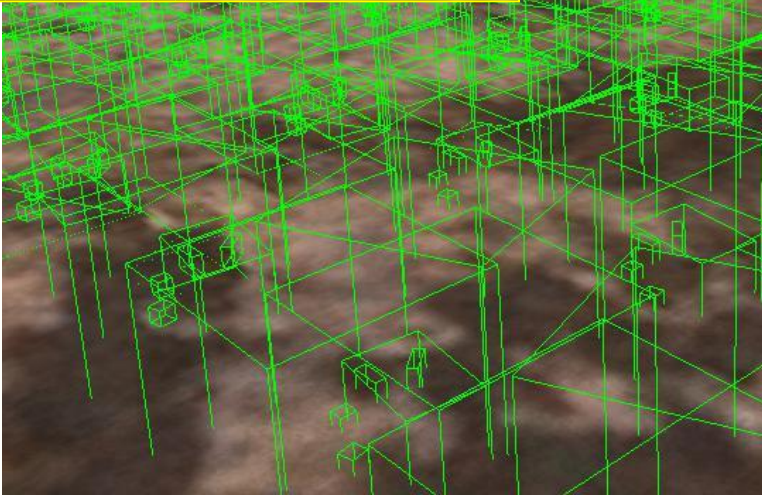
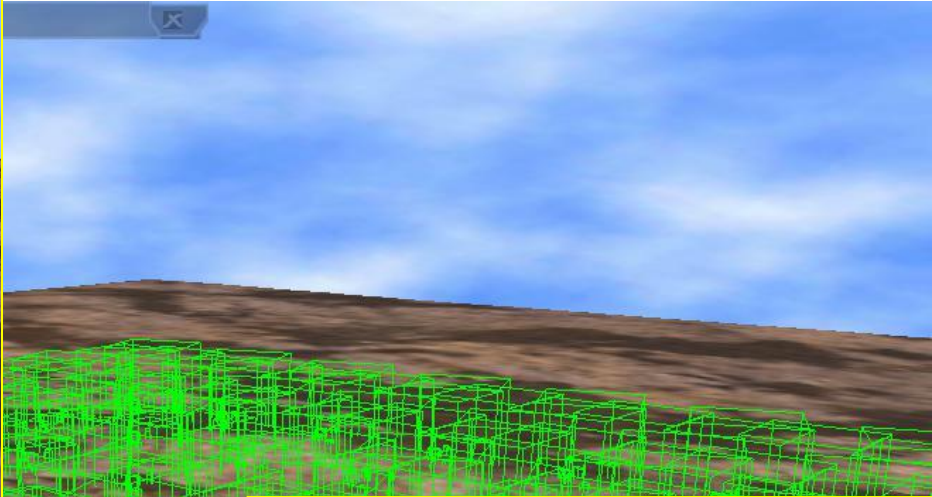
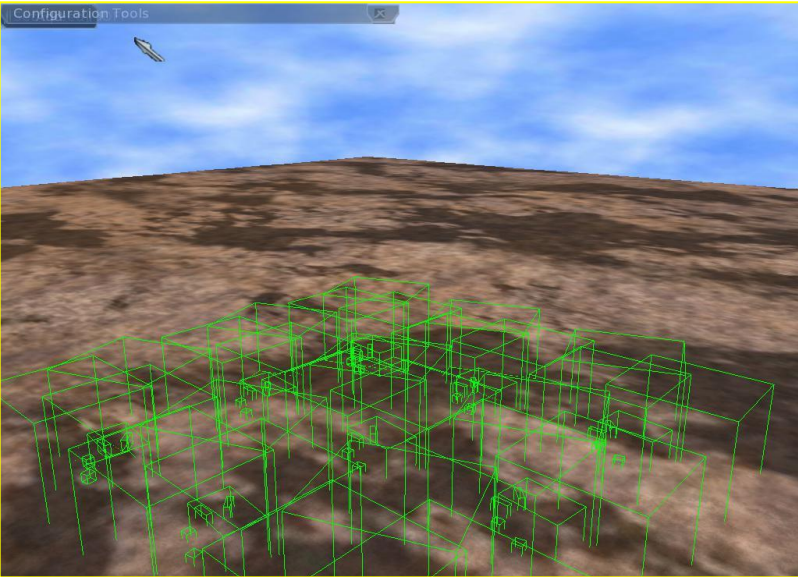
Sort-Last Visualization Algorithm



Scene Complexity



Scenario Description



Scenario Execution



- Camera control: 1st person perspective



- Camera control: 3rd person perspective

Thanks, Questions

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