UNESCO-IHE
Institute for Water Education

Earth Science Oriented Data Processing Tools and Applications for Black Sea Catchment Basin

MINISTRY OF EDUCATION AND RESEARCH

TECHNICAL UNIVERSITY
OF CLUJ-NAPOCA

CGIS
Computer Graphics
and Interactive Systems

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Workshop subjects

Time	Subject	Instructor
13:45 -14:05	enviroGRIDS project overview: Portal, Tools and Applications	Dorian Gorgan
14:05 - 14:25	Grid based processing and data management	Victor Bacu, Denisa Rodila, Dorian Gorgan
14:25 - 15:15	SWAT model calibration and execution by gSWAT application	Victor Bacu
15:15 - 15:45	coffee break	
15:45 - 16:00	Interoperability between Geospatial and Grid infrastructures	Denisa Rodila
16:00 - 17:00	Spatial data visualization by BASHYT	Pierluigi Cau, Simone Manca
17:00 - 17:15	Remote sensing applications	Victor Bacu, Dorian Gorgan
17:15 - 17:30	Training in Earth Sciences by eGLE	Dorian Gorgan

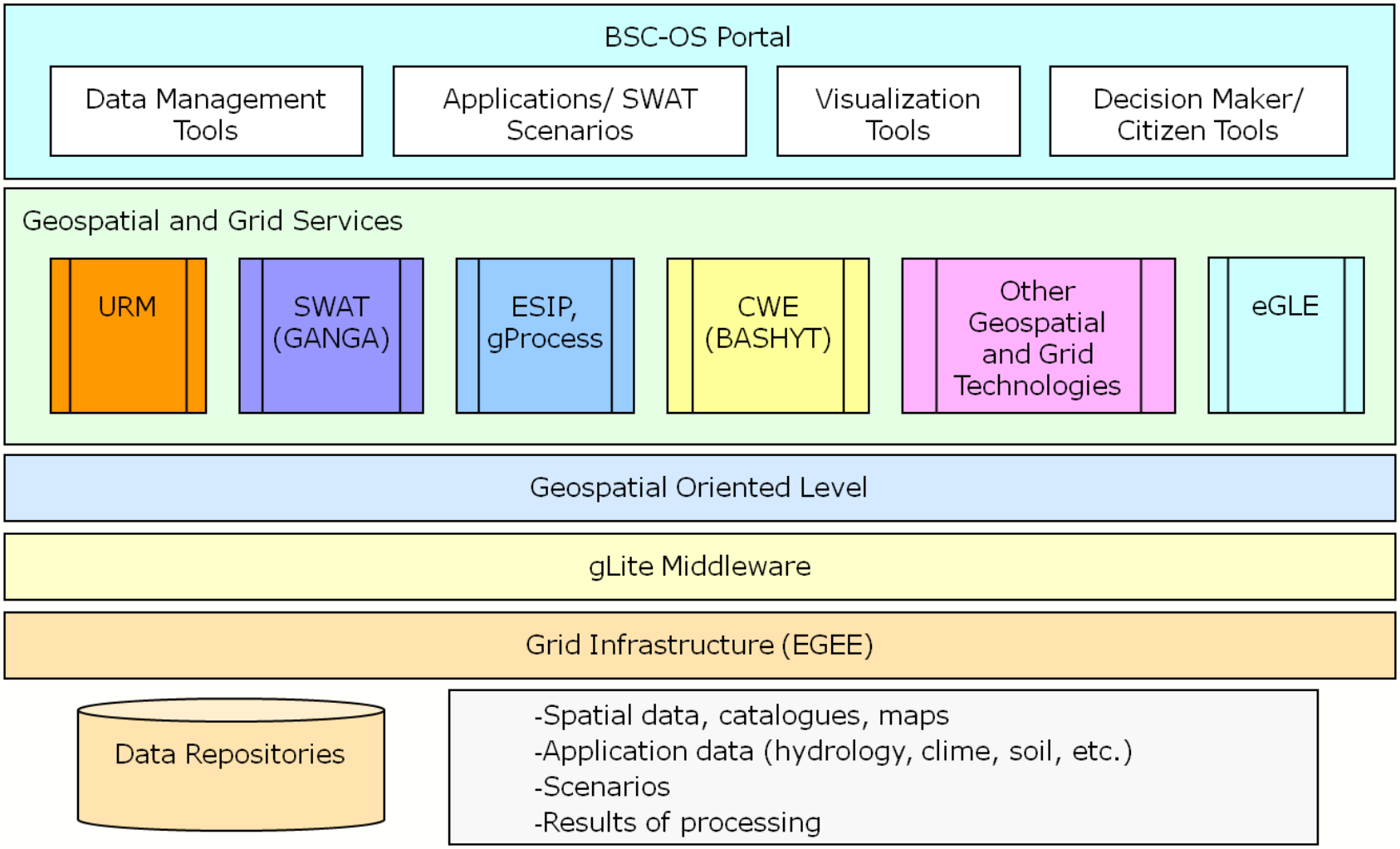
enviroGRIDS Project

- **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
- Objectives:
  - Develop a SDI (Spatial Data Infrastructure) targeting the Black Sea catchment region
  - Use new international standards to store, analyze, process, and visualize important information regarding this area
  - Perform distributed spatially-explicit simulations of environmental changes

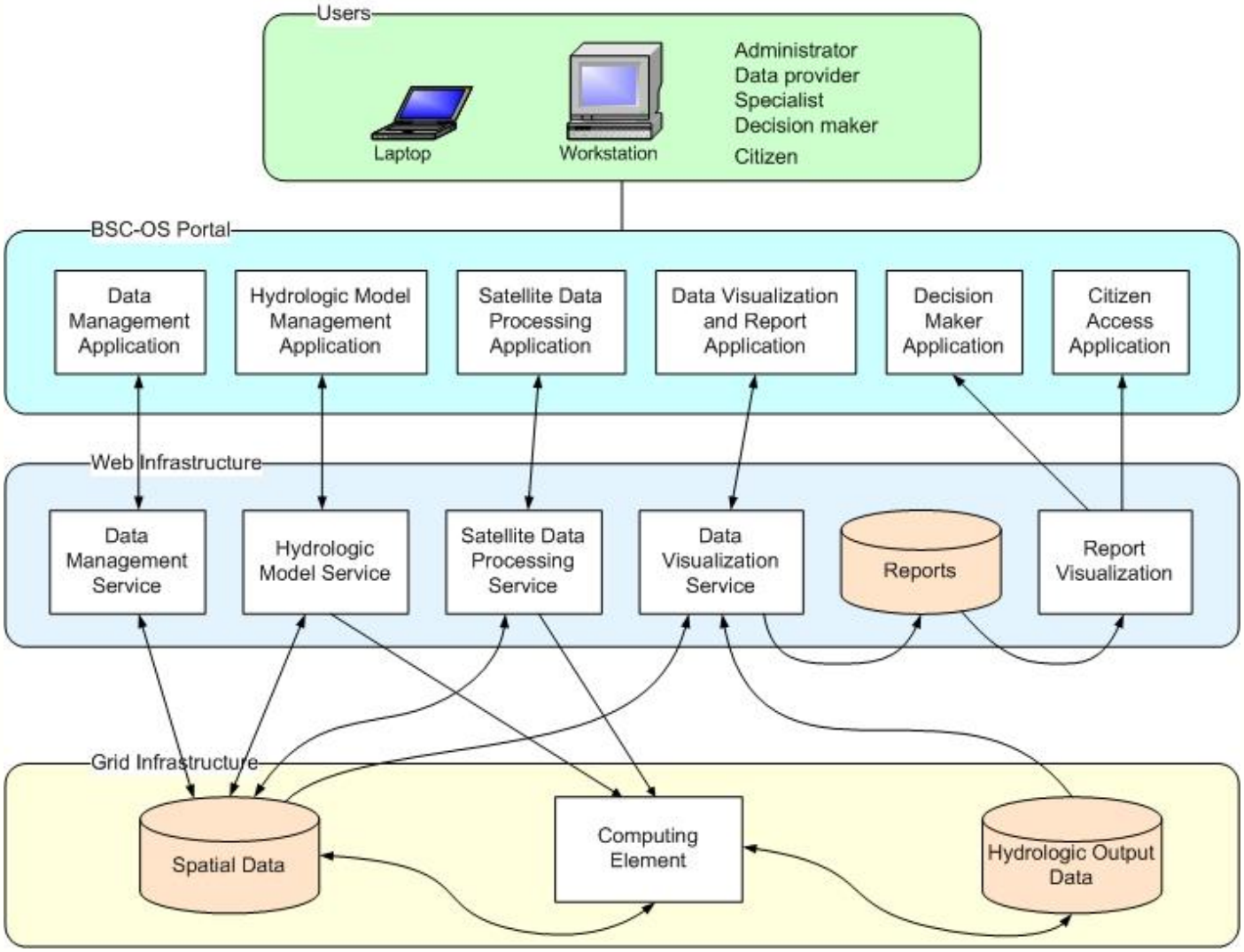
BSC-OS Portal

- 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

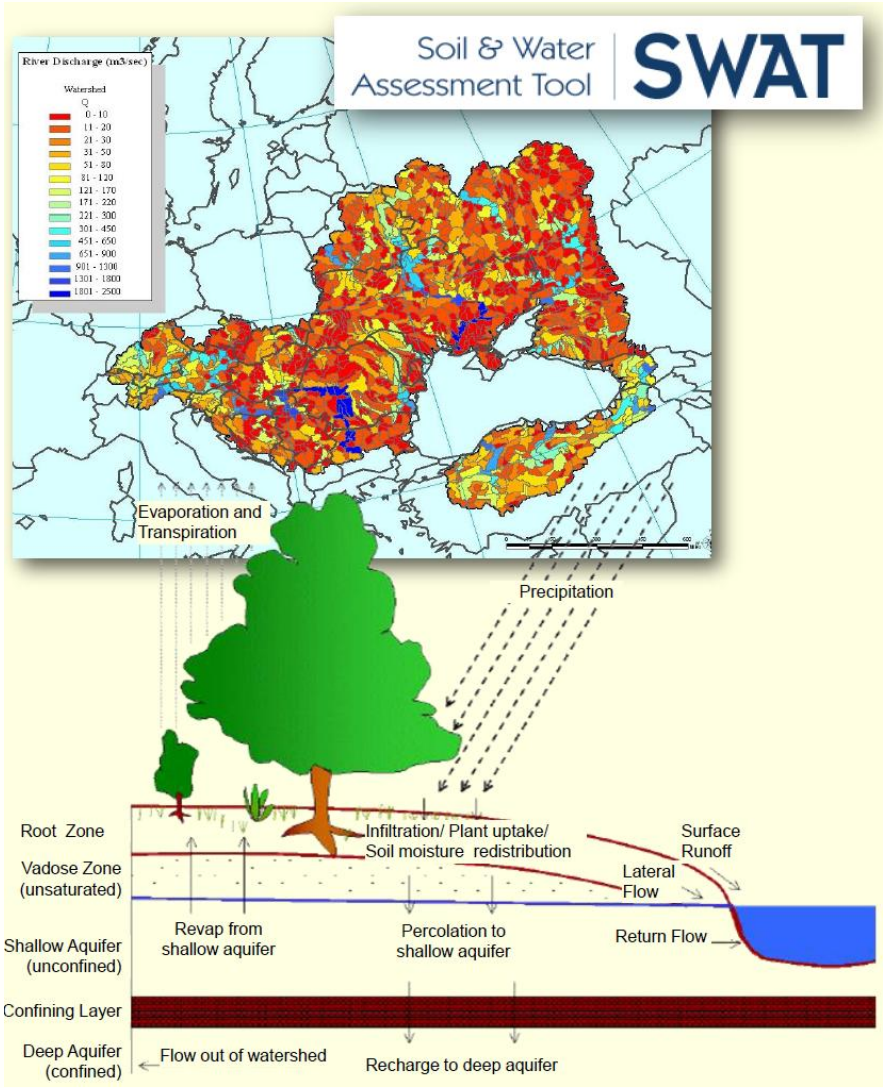


Specific Objectives

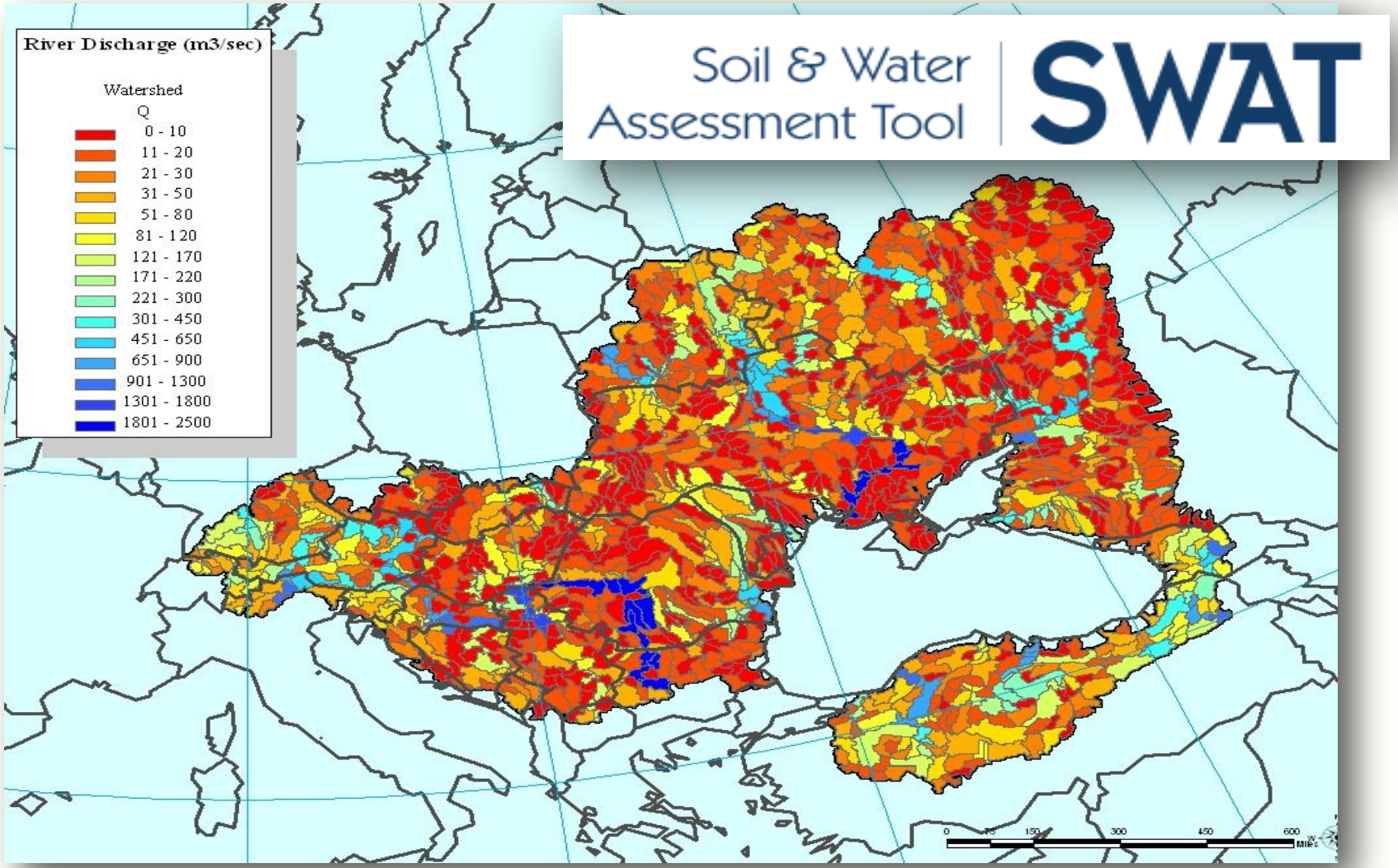
- Link, gather, store, manage and distribute key environmental data concerning the Black Sea Catchment Basin
- Large scale and high resolution distributed hydrological models
- Gridification of tools and applications
- Model and process huge spatial data over the Grid (e.g. hydrological models, satellite 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



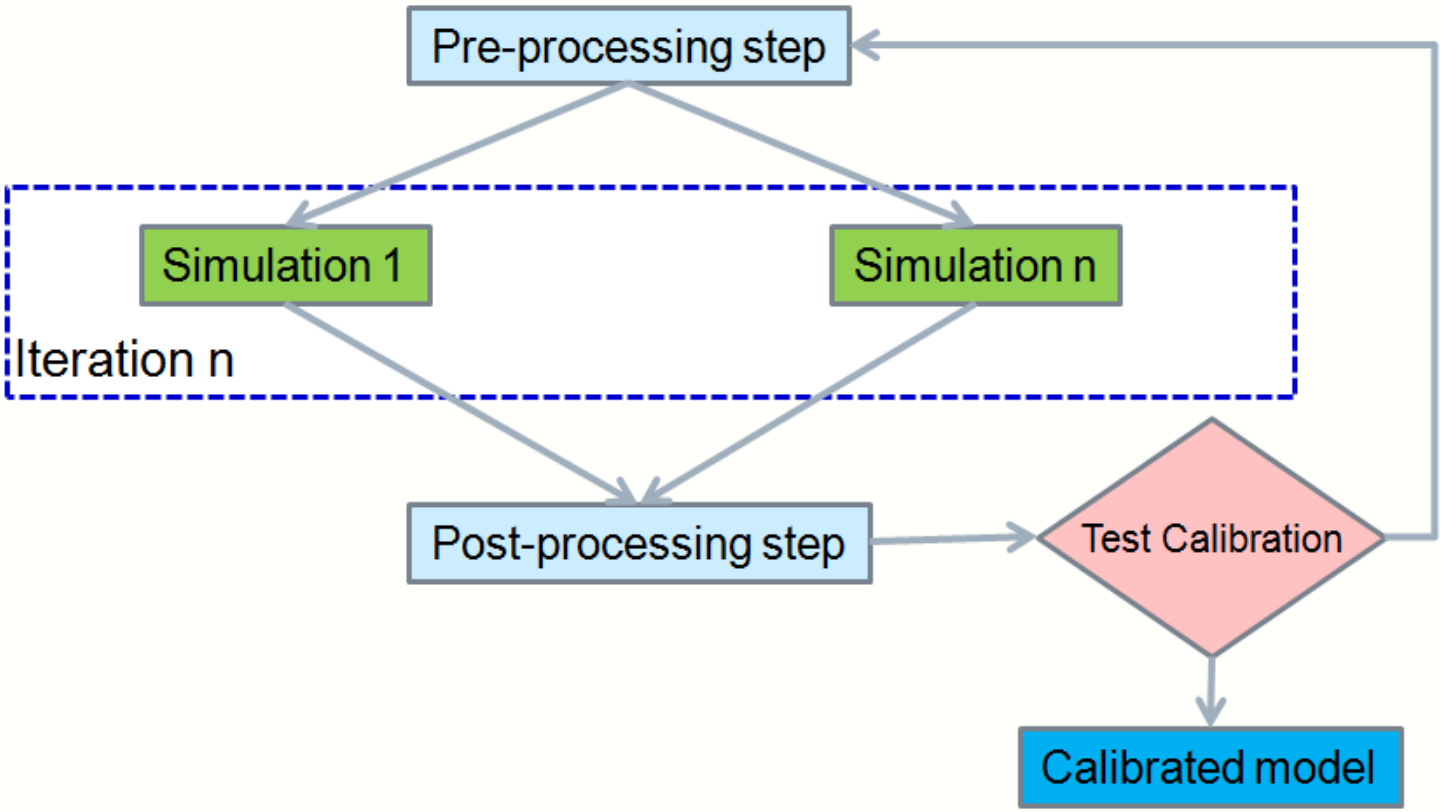
Grid Based Processing

- 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

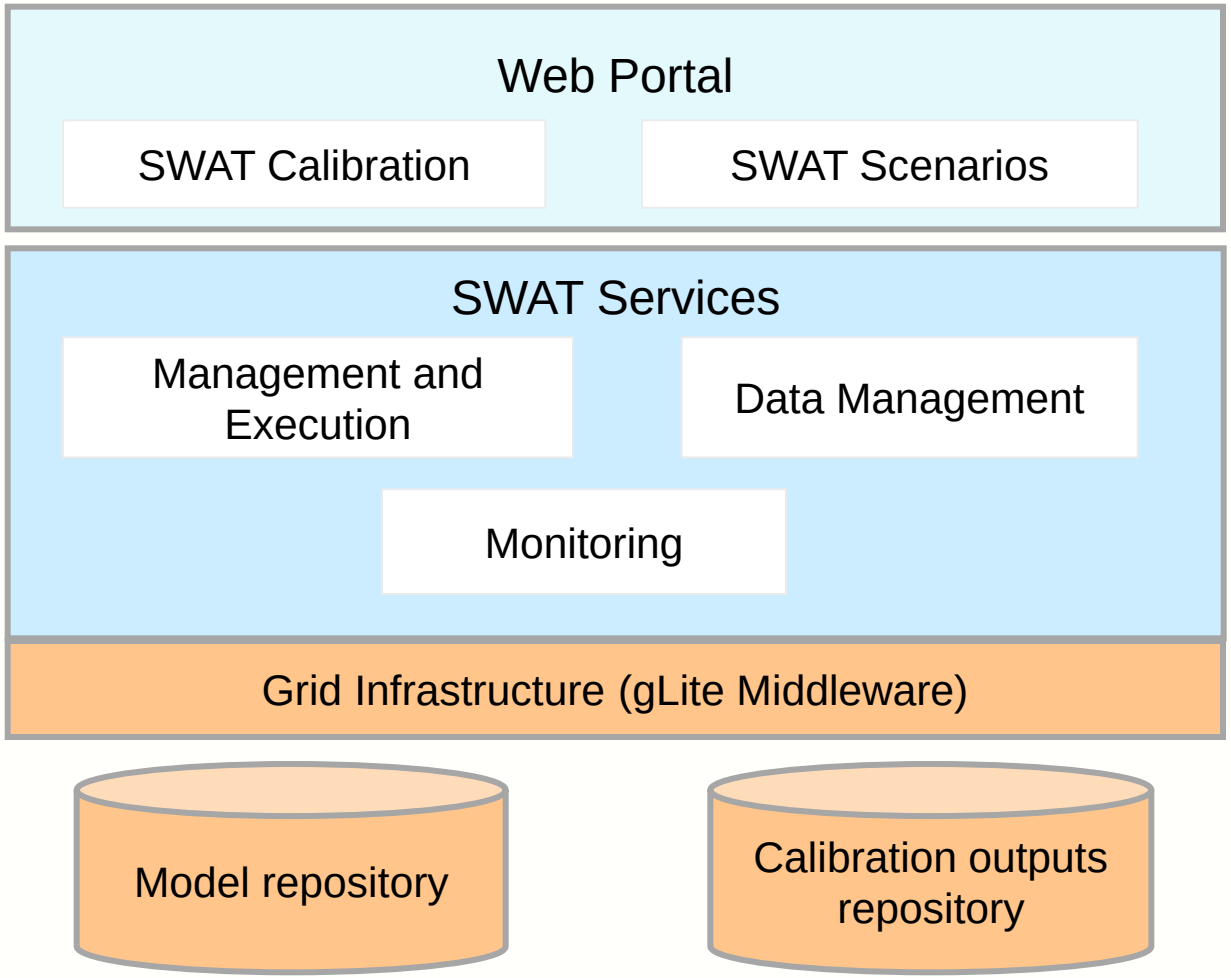
gSWAT Application

- 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

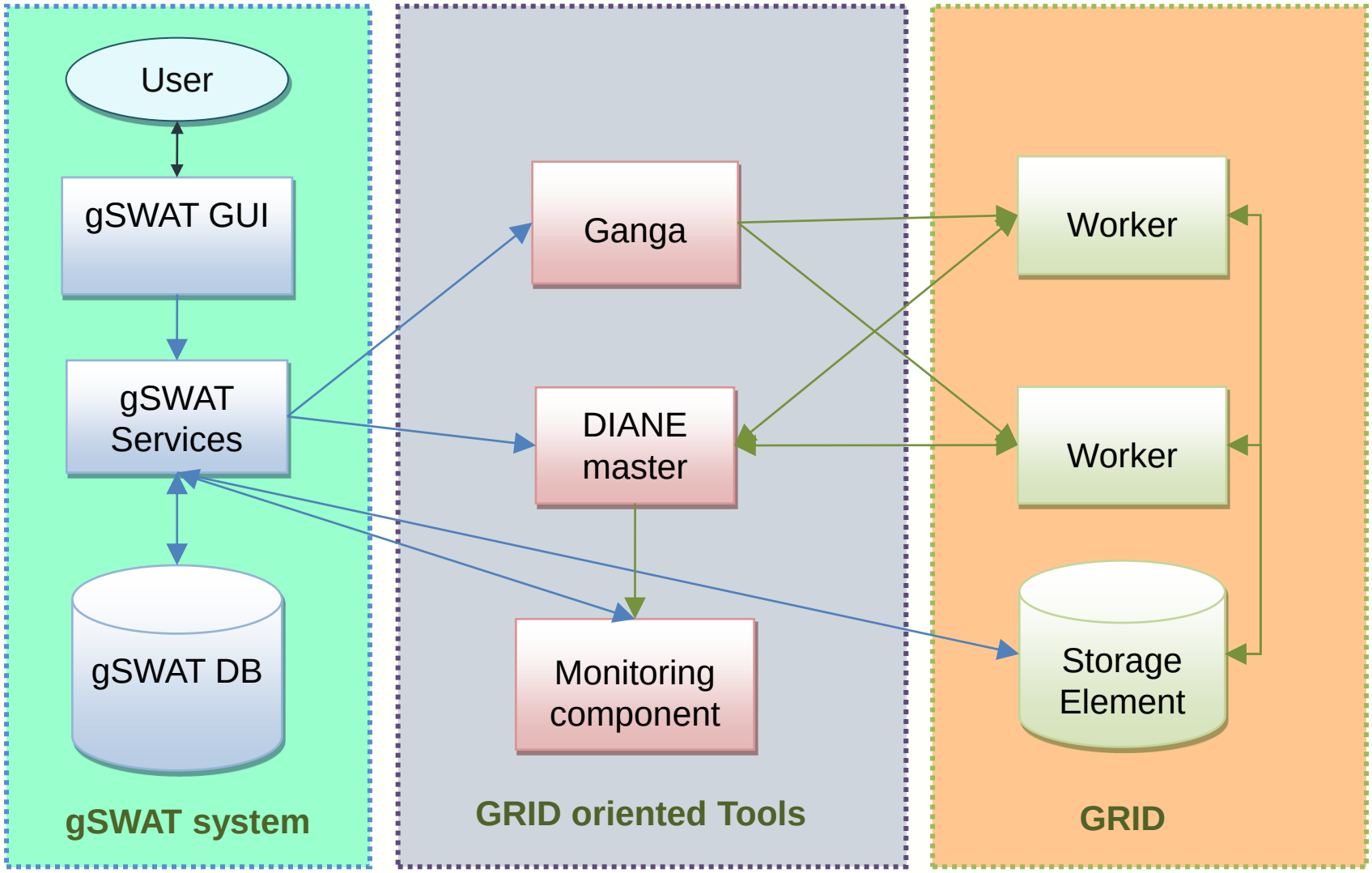
Processing Steps



gSWAT Application - Architecture

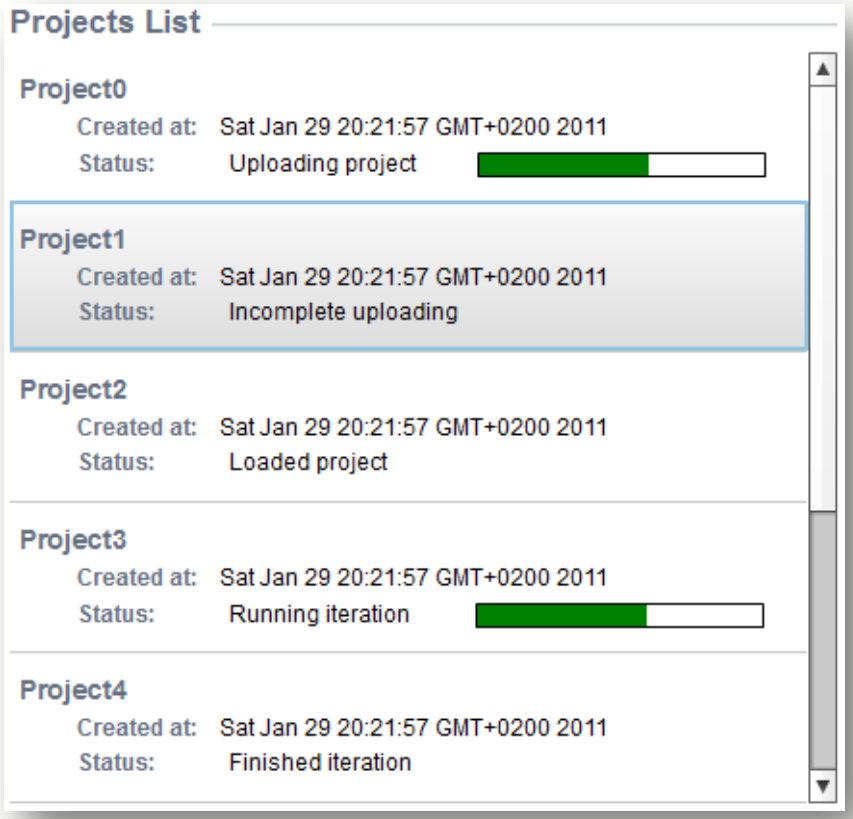


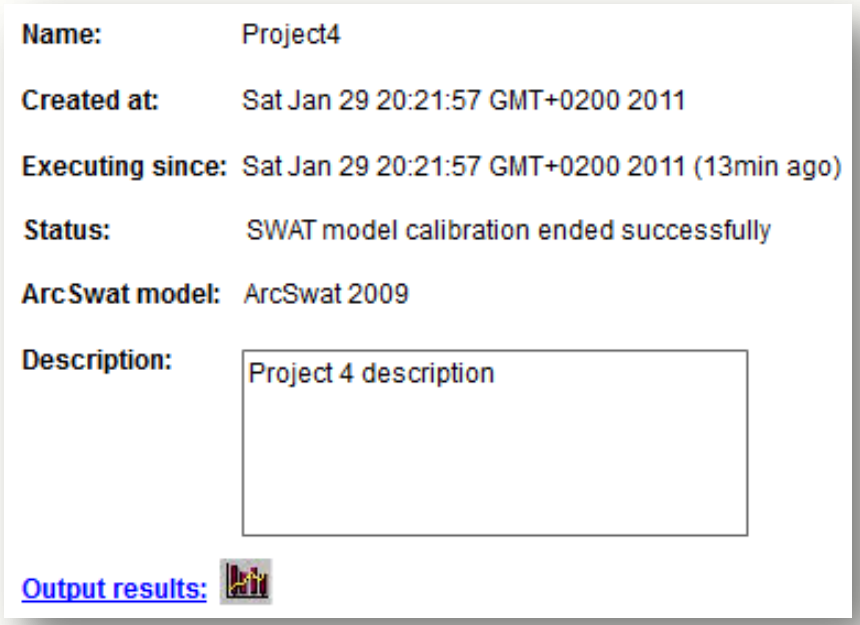
gSWAT Control Flow



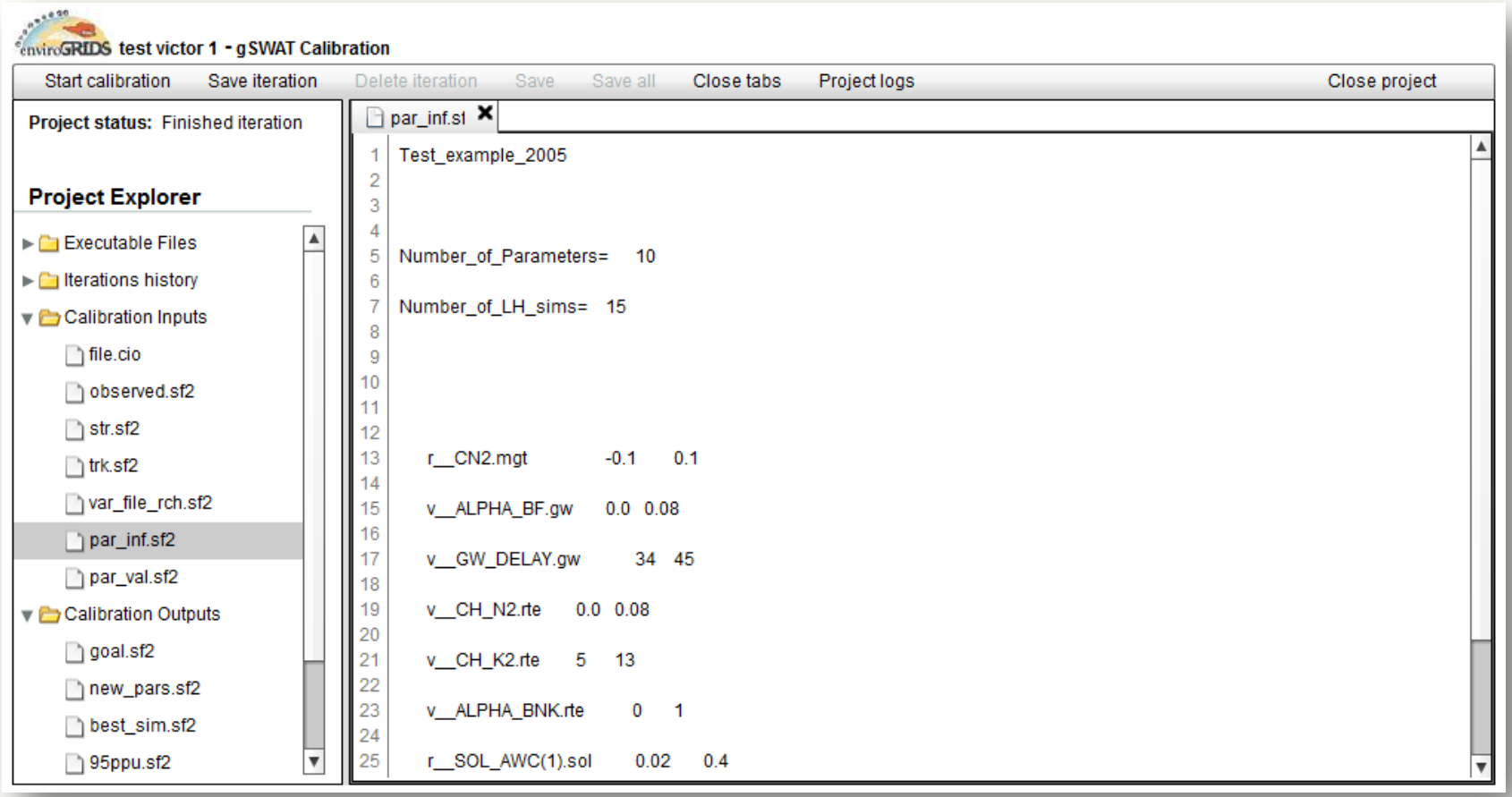
gSWAT User Interface

- Project list and detailed information on the selected project

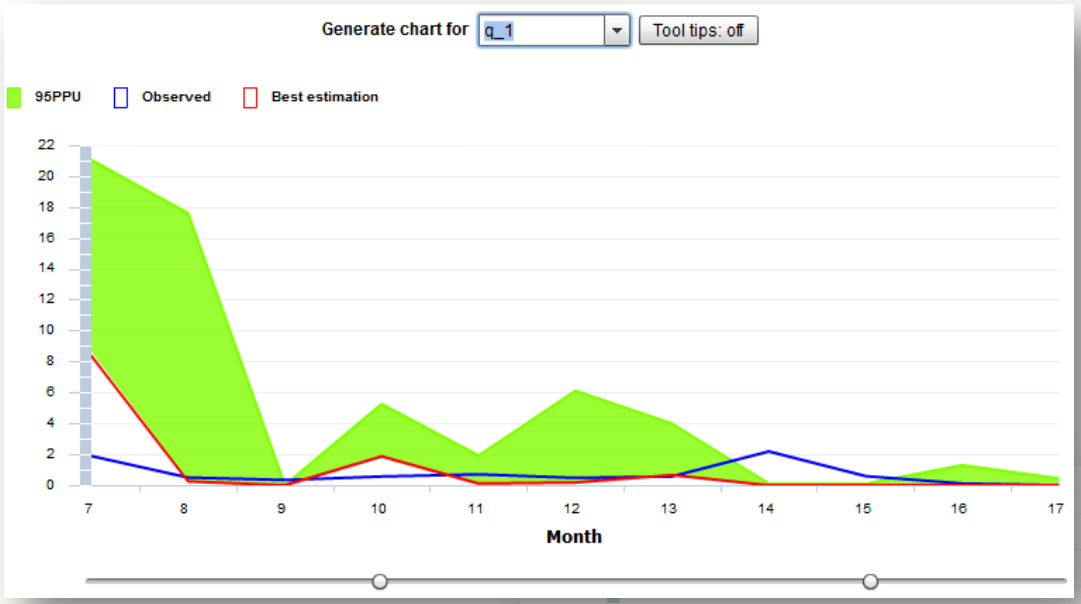


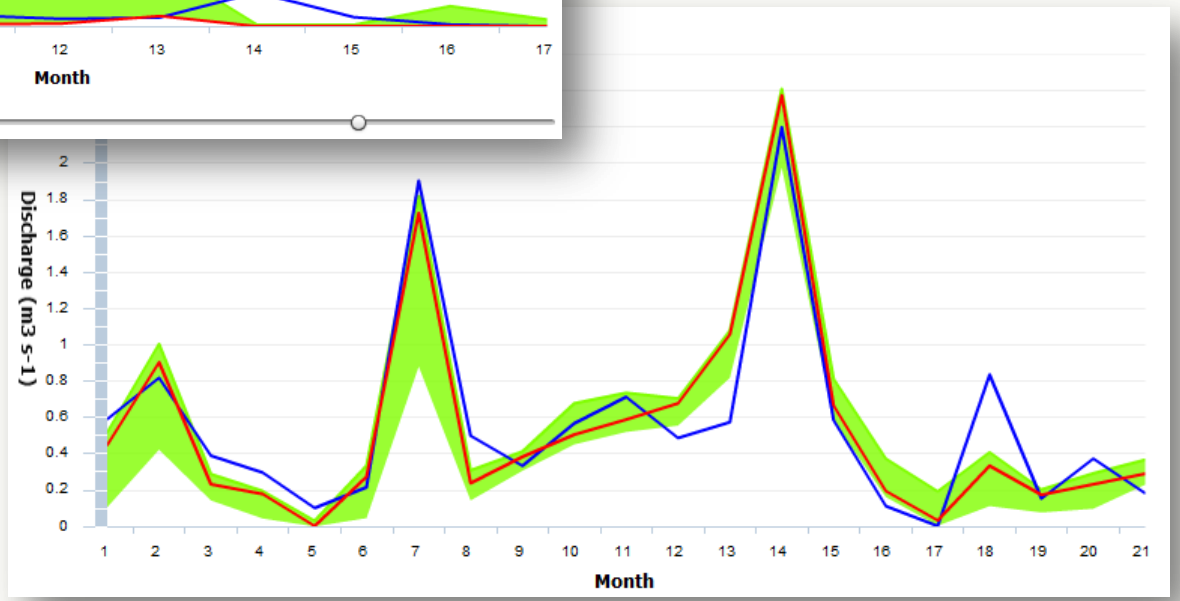


Modify SUFI2 Calibration Parameters

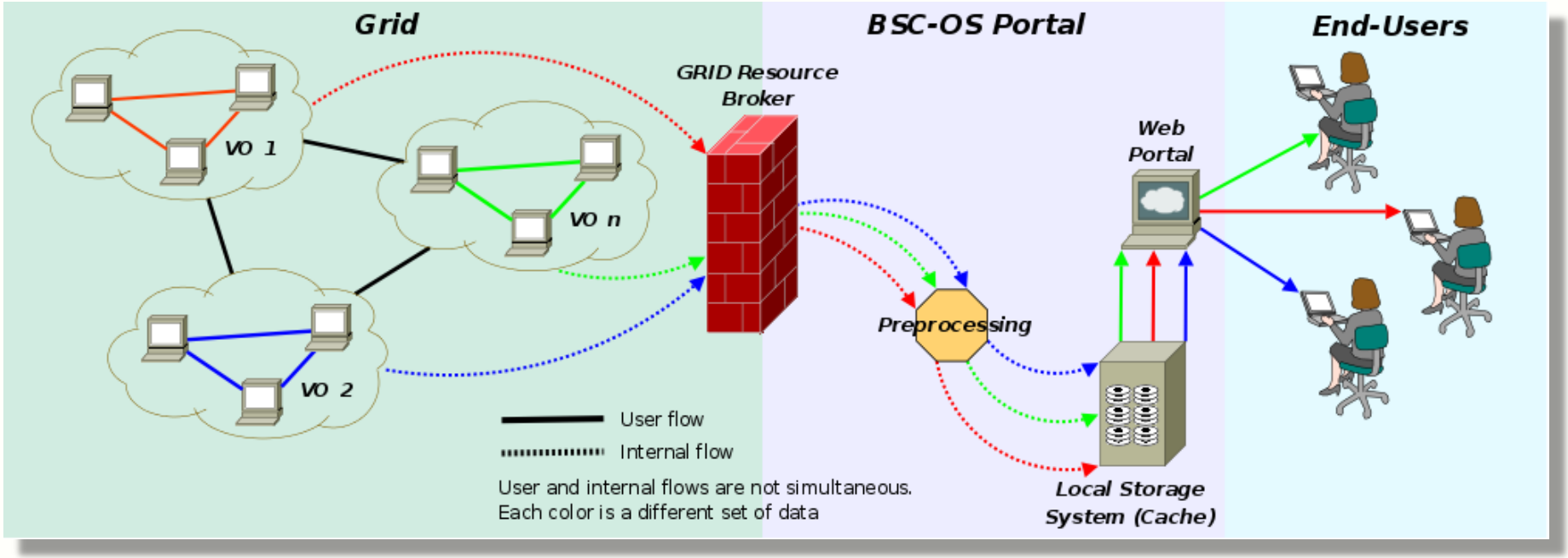


Calibration Output Visualization

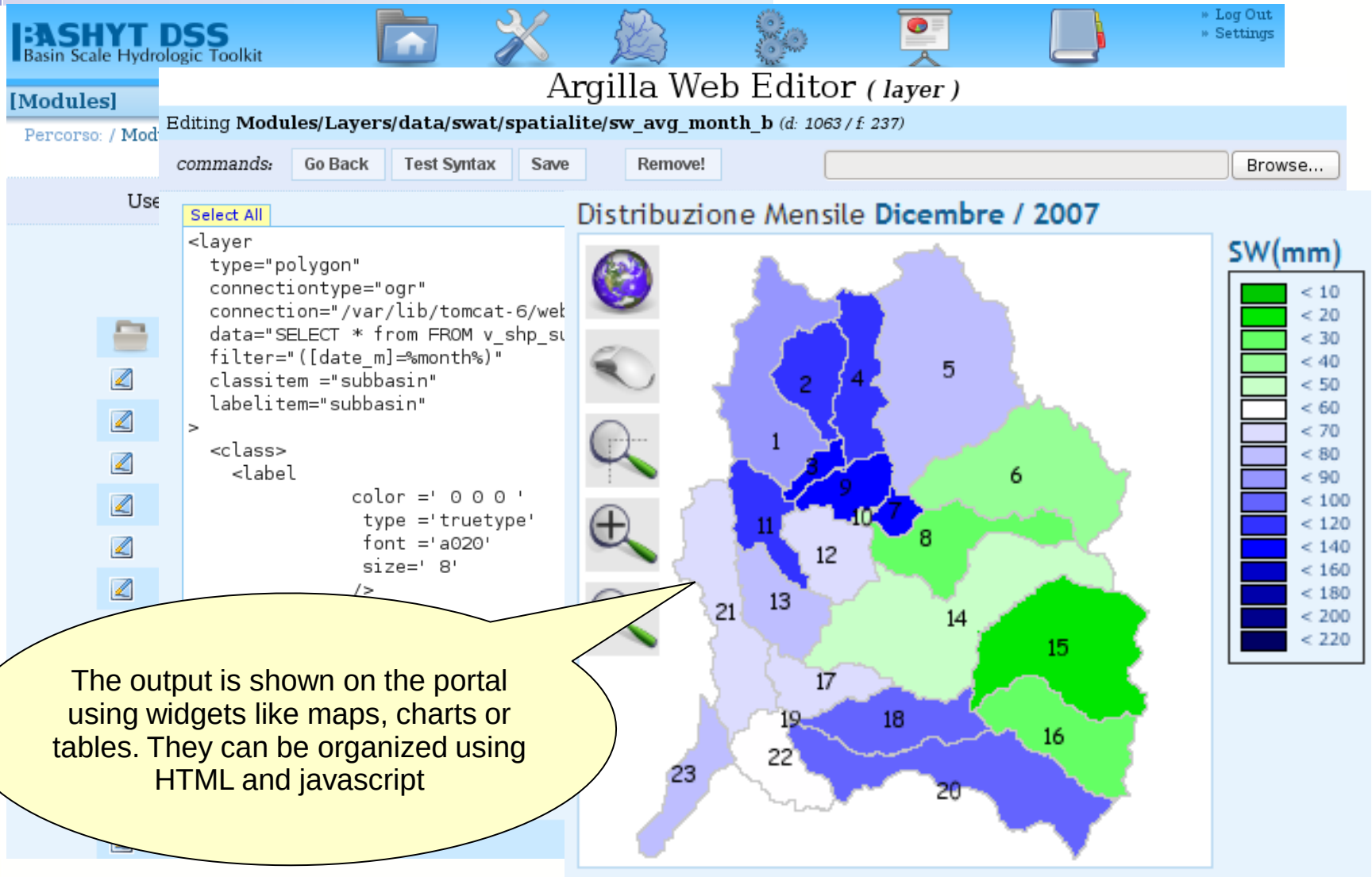




Spatial Data Visualization by BASHYT

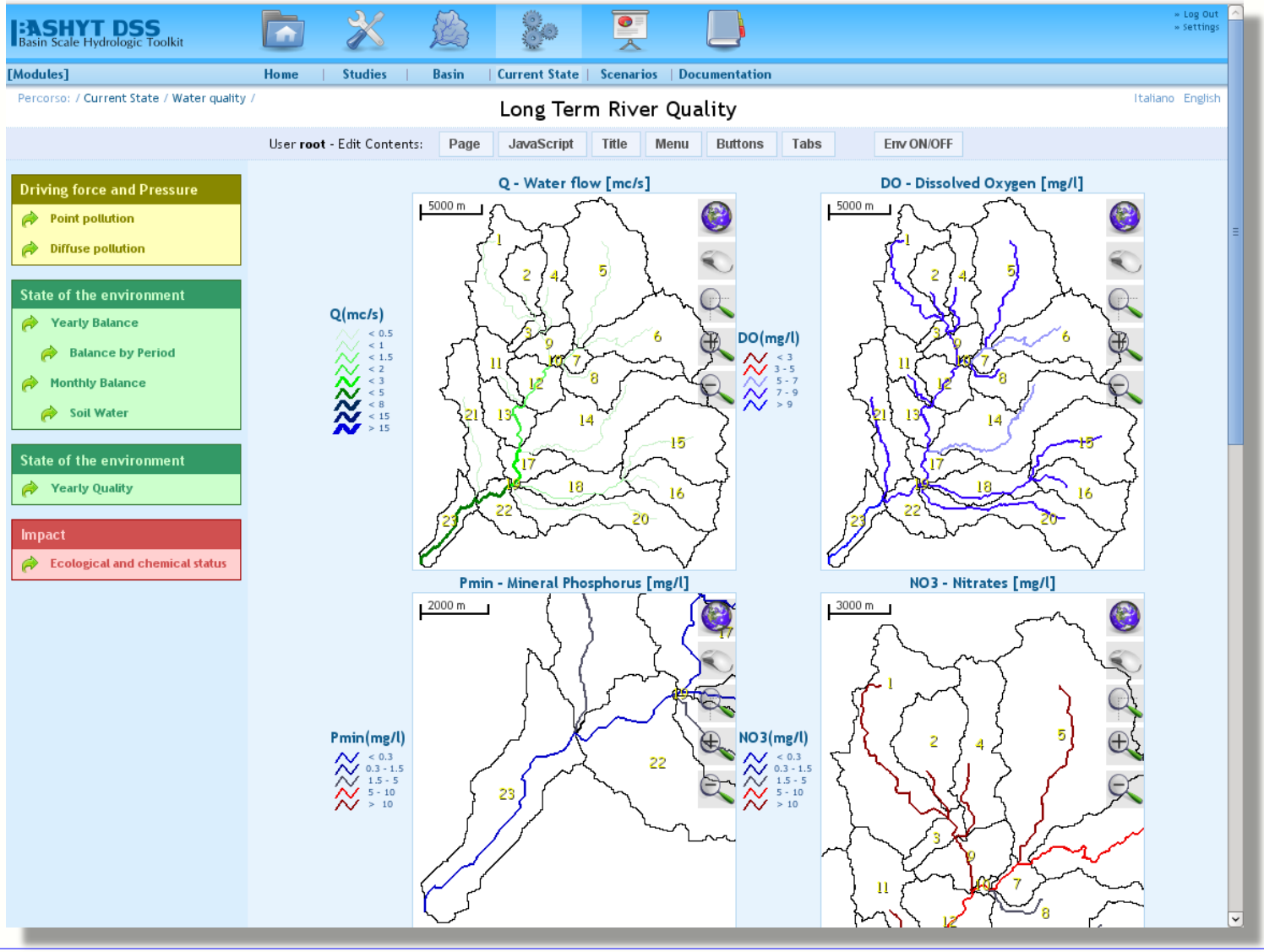


Graphical User Interface Development



The output is shown on the portal using widgets like maps, charts or tables. They can be organized using HTML and javascript

Spatial Data Visualization



Satellite Image Processing

- Explore images to identify objects and give them a significance
- Analysis: detect, identify, classify, measure and evaluate the significance of physical and cultural objects, their patterns and spatial relationships
- Applicability in different Earth Science domains
  - Land cover
  - Air pollution
  - Hydrology
  - Ecology
  - etc

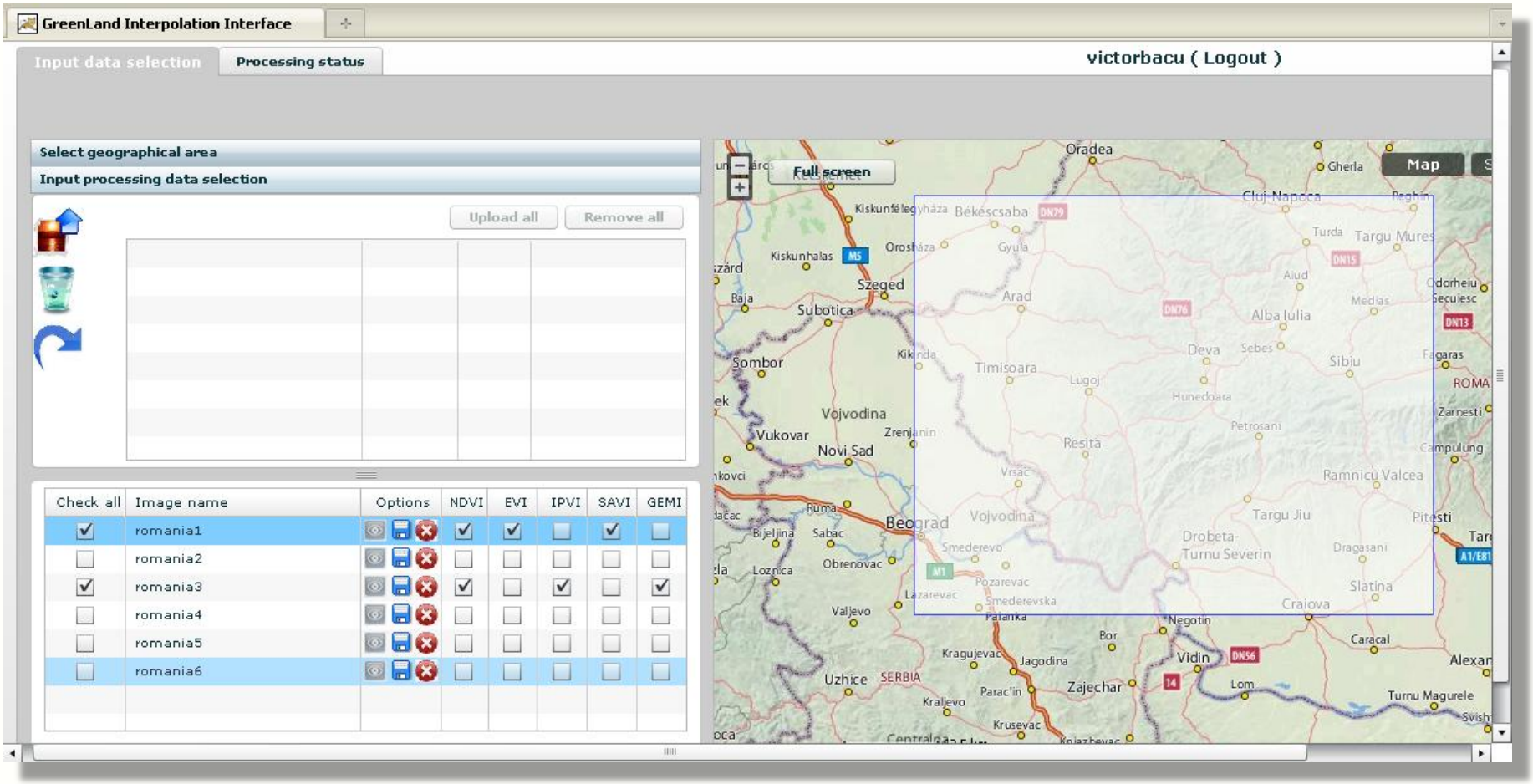
Satellite Image Processing

- Satellite image types used for different purposes
  - Landsat
  - MODIS
  - Aster
  - Quickbird, etc
- Size: depending on the geographical region size and on the containing information, satellite images could reach a couple of Gb in size

GreenLand Vegetation Indices

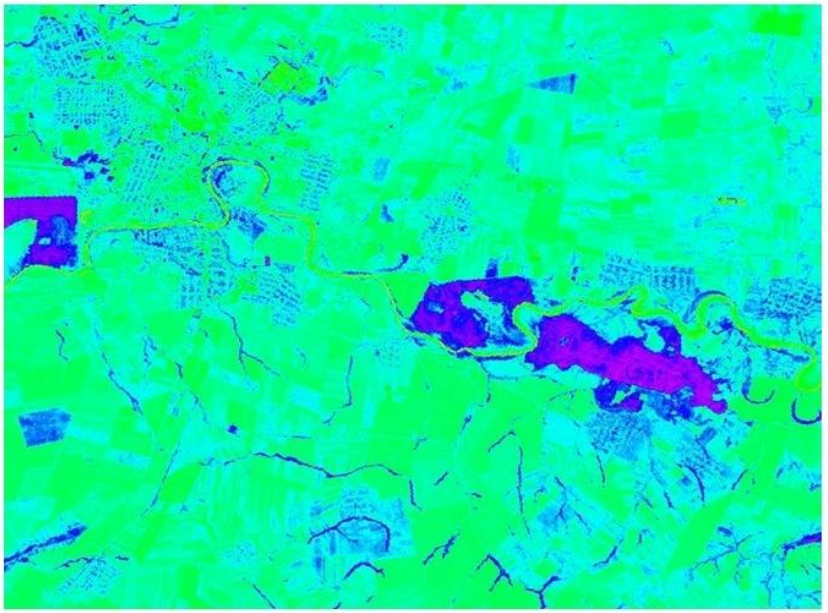
- Vegetation index based image classification
  - NDVI (Normalized Vegetation Index)
  - EVI (Enhanced Vegetation Index)
  - IPVI (Infrared Percentage Vegetation Index)
  - GEMI (Global Environment Monitoring Index)
  - SAVI (Soil-Adjusted Vegetation Index)
- Classification process - combines different bands in the Landsat satellite images in order to correctly make the classification

GreenLand App. - Satellite Image Proc.

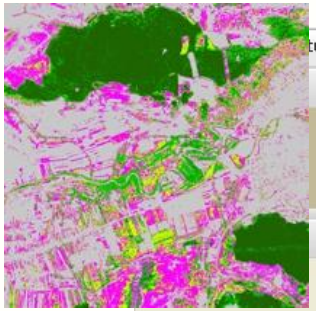


GreenLand Application

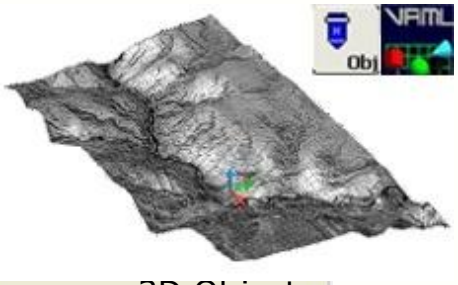
- Classification output (right image) based on input satellite image (left image)



Virtual Training Center -Lessons

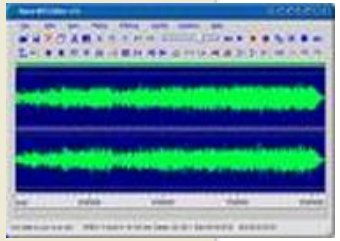


Images



3D Objects

Videos



Sounds

Documents

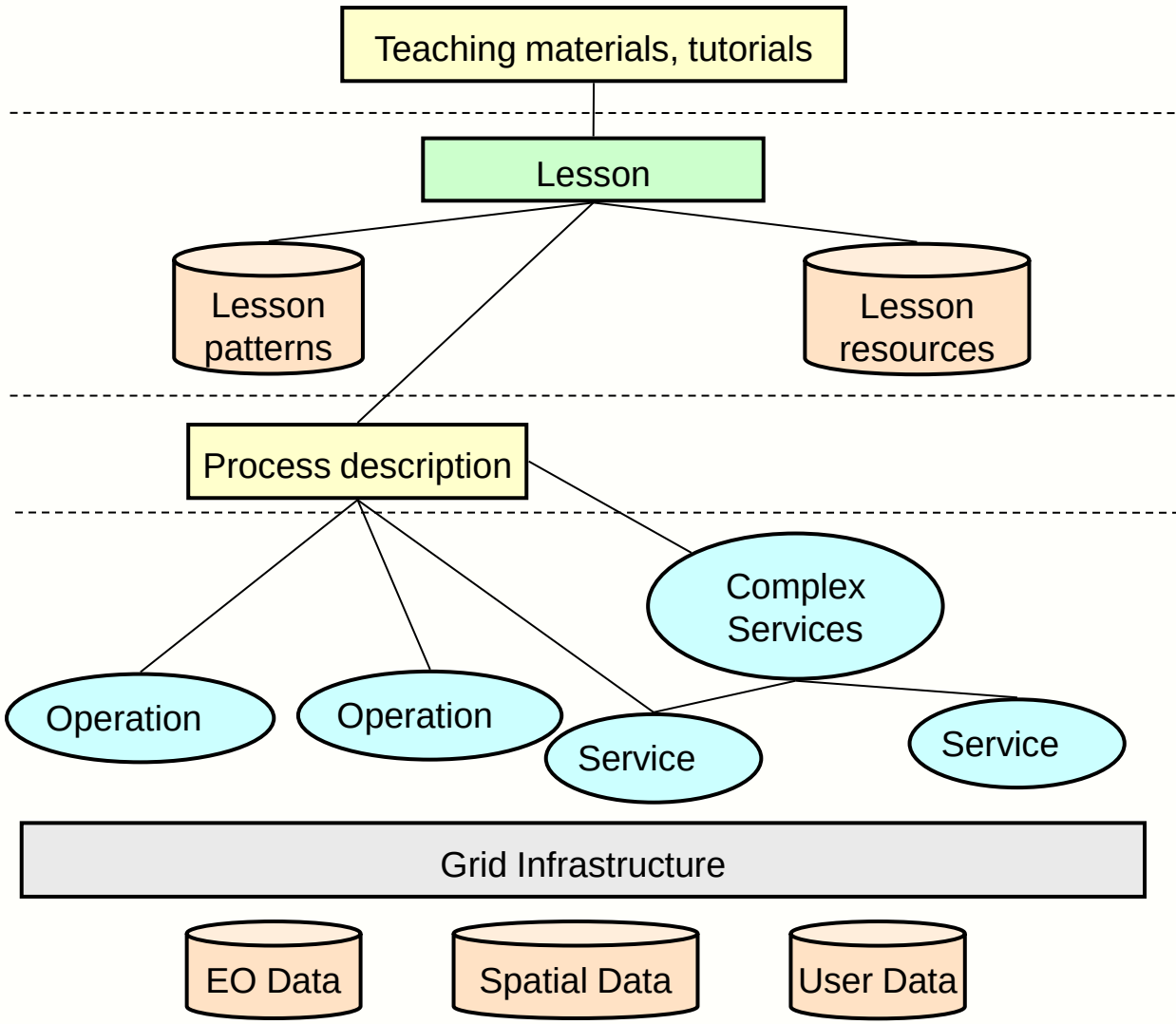
Other multimedia content

Lesson Visual Structure

Template

Pattern 1	Lesson Title		
Pattern 2	Static image	Static text	
Pattern 3	Dynamic text	Video	Slideshow
Pattern 4	Dynamic image	Processing graph editor	
Pattern 5	Animations = step by step results of complex processing algorithms		

Teaching Material Description



Teaching materials of various topics and subjects.

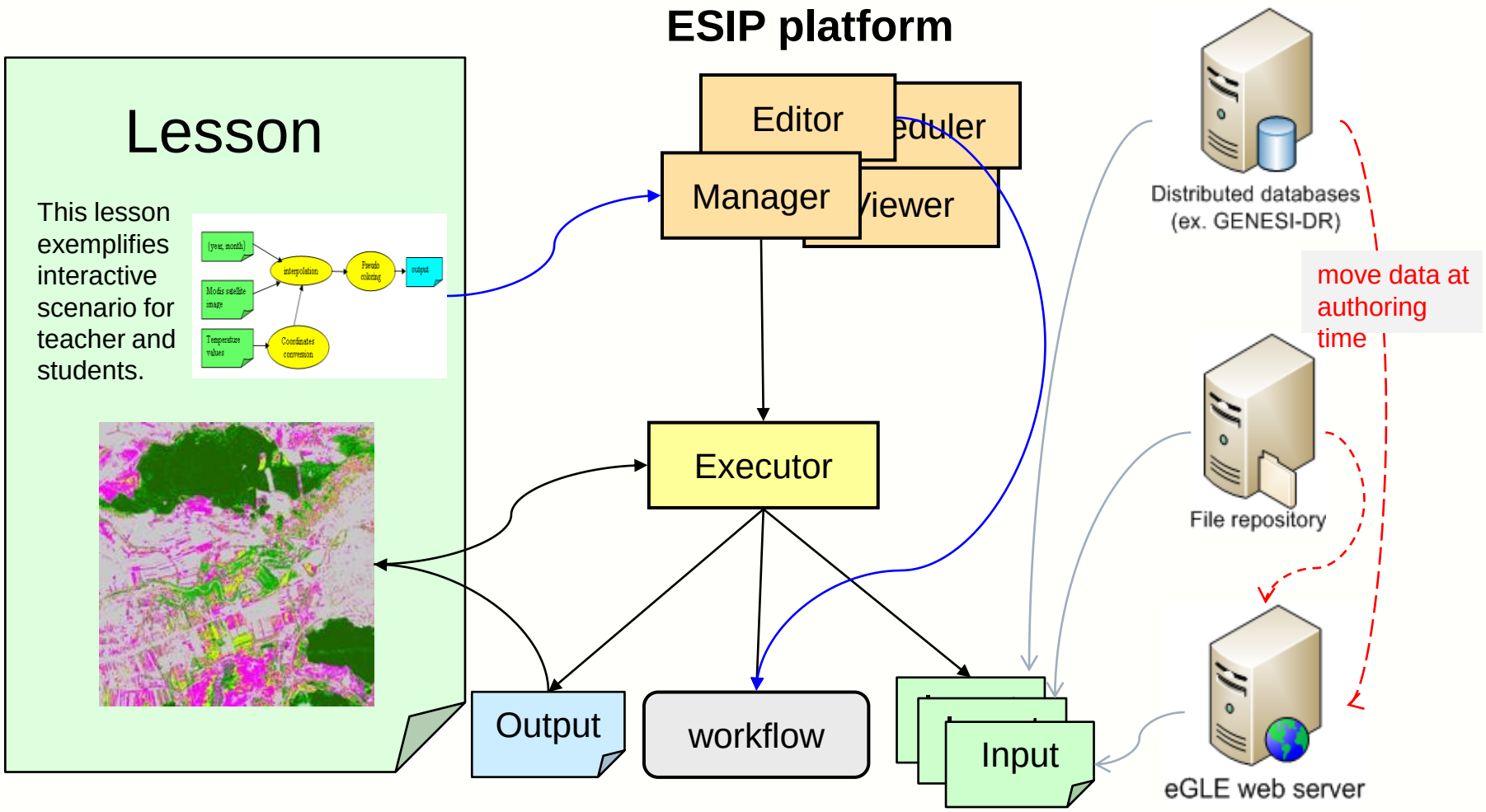
Lesson description, execution, and management.

Workflow based process description.

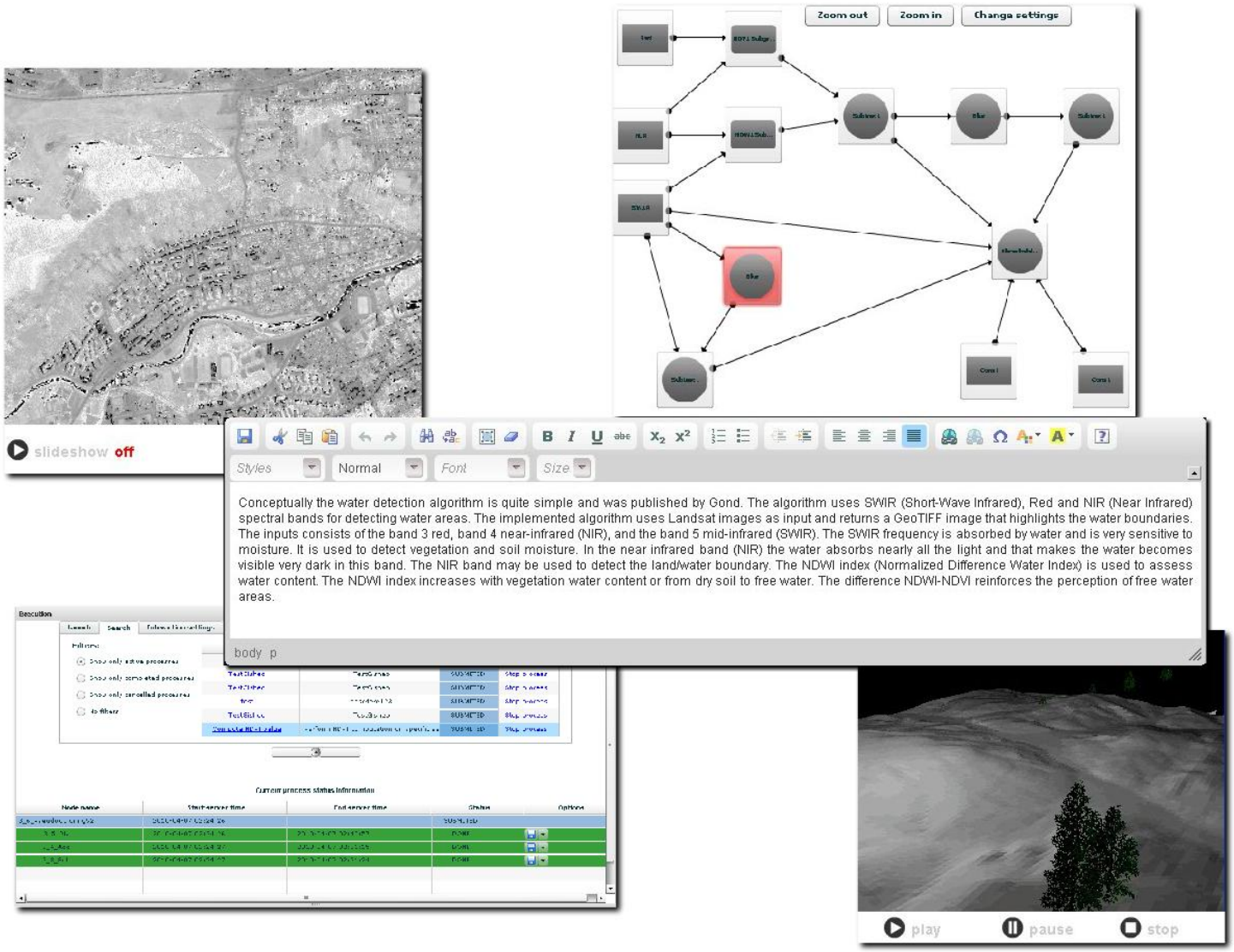
Service description, search, discovery and composition.

Services, operations provided through Web

Grid Based Execution of Env. Scenarios



eGLE Tools



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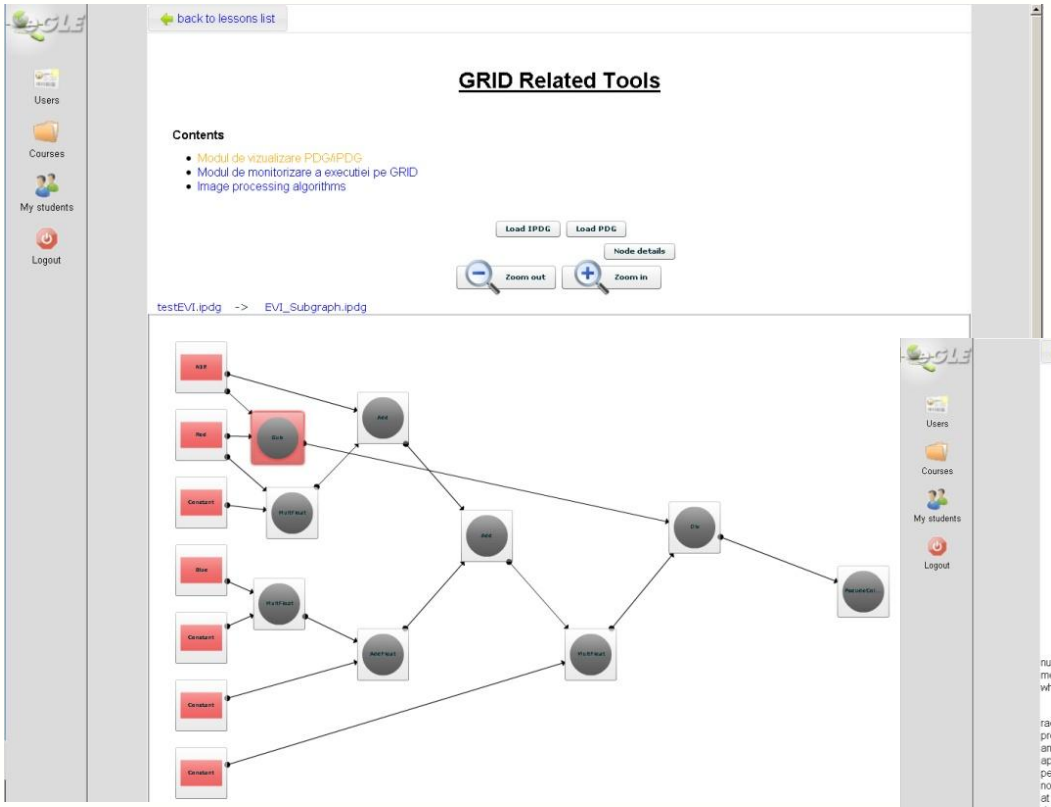
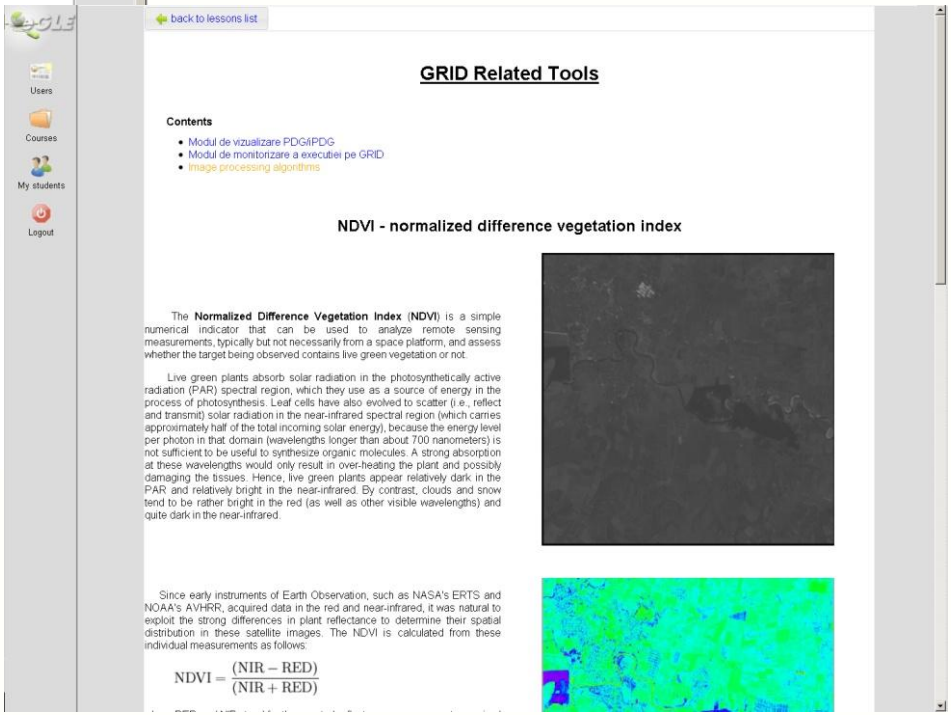
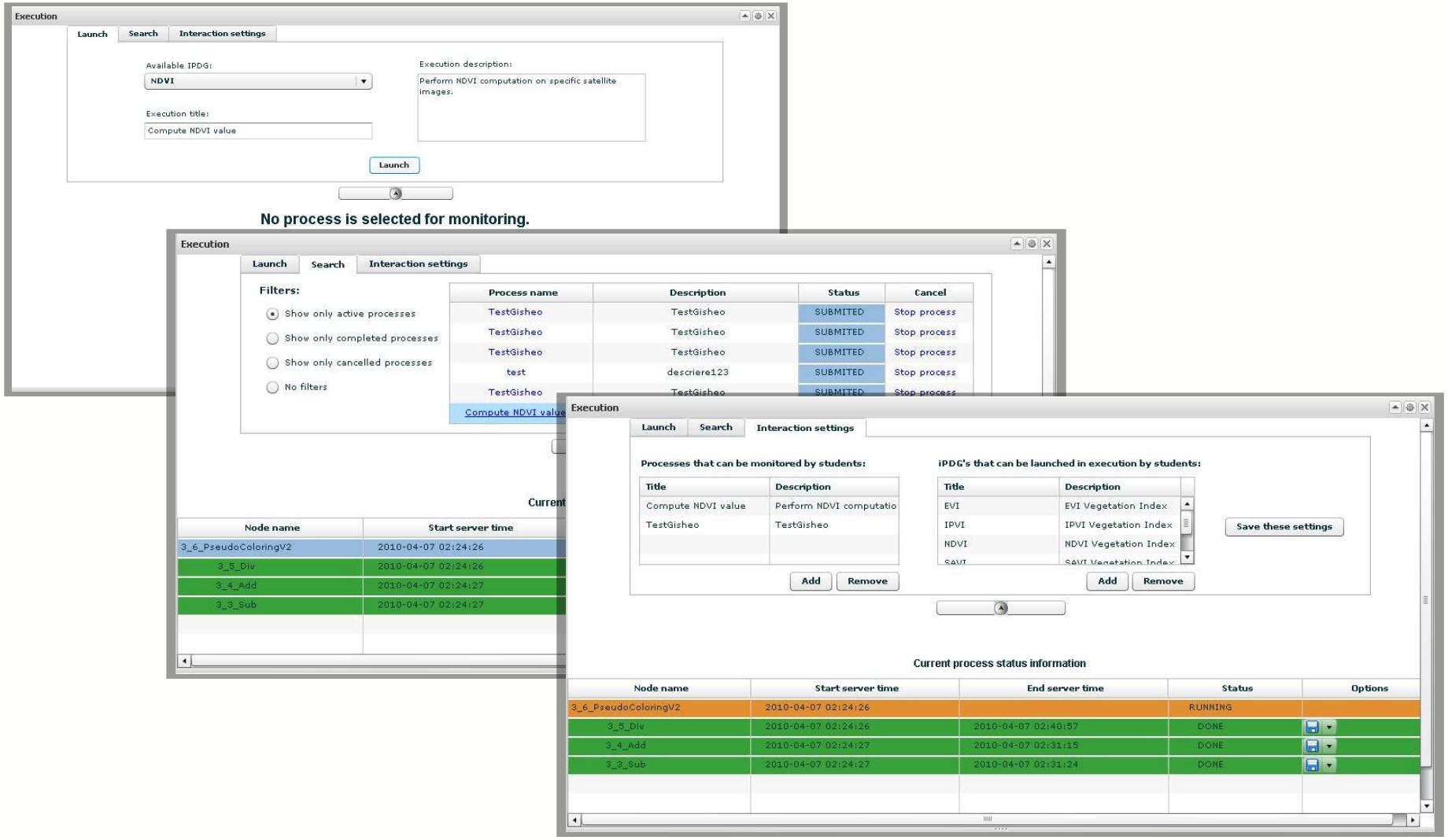
Lesson Samples – GRID Oriented Tools





Lesson Execution Monitoring



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Future Works

- Improve the functionality and the performance of the applications
- Tools and applications for the interactive development of hydrological scenarios
- Interoperability between different technologies involved in the enviroGRIDS project
- Include and develop new tools and applications required by the partners (e.g. RIONI River hydrological model, Vegetation development in Istanbul, etc)
- Develop training materials in the domain of Earth Sciences

Thank you for your attention!

Questions?

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