GreenLand v1

A Grid based application for satellite image classification

Contents

1. Introduction

This manual intends to clarify how a non-expert person could use GreenLand application, in order to fulfill its needs. This presentation begins with a short introduction that highlights the main objectives of the GreenLand application. The middle section presents the execution flow of a process, starting with the selection of the input data set, and ending with the result processing. The last section (Conclusions) points out the problems encountered in the development process and also new research directions, regarding GreenLand application.

1.1 General overview

GreenLand application is used in the classification field of the Landsat satellite images, and also used in the process of creating thematic maps. A thematic map contains information about the distribution of specific elements in nature (e.g. soil, water, air, vegetation, etc). The classification of vegetation is an important component of the management and planning of natural resources. This offers useful information for the classification of the ecological and habitat diversity, monitoring of fires, risk management (avalanches, floods, landslides, etc.) and control of vegetation health.

The classification is performed based on vegetation indexes, like: NDVI *(*Normalized Difference Vegetation Index), EVI (Enhanced Vegetation Index), IPVI (Infrared Percentage Vegetation Index), GEMI (Global Environmental Monitoring Index*)* and SAVI (Soil-Adjusted Vegetation Index).

1.2 Existing versions of the application

In order to test the functionality and the human-computer interaction techniques, a useful link was provided. Here you can launch new processes over the Grid infrastructure, get latest updates of the processes status and visualize the results in a user-friendly manner.

http://cgis.utcluj.ro:4331/GreenLand1.3/

2. User scenario

This section shortly describes how a user could launch new processes in execution on multiple nodes of the Grid infrastructure. The input data set selection as well as the result management is covered in this section.
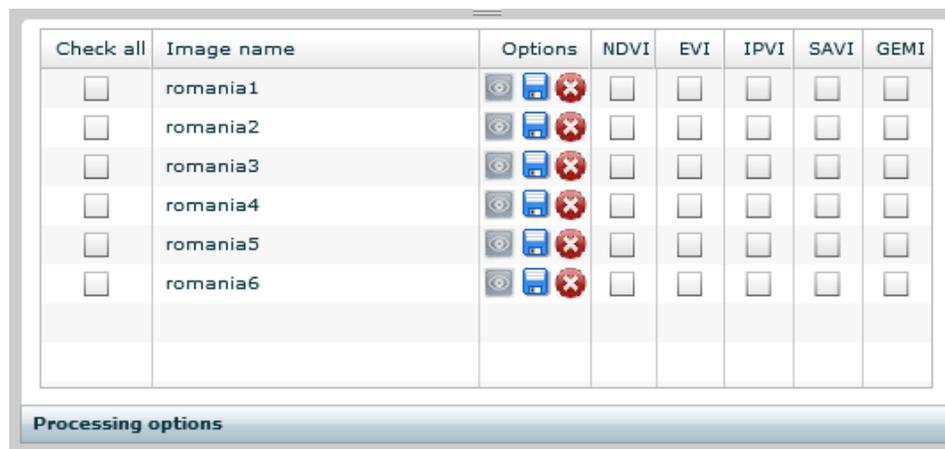
2.1 Method presentation

The main goal of this application is to be used in the classification field of the Landsat satellite images, and also used in the process of creating thematic maps. Taking this into account new human-computer interaction techniques was implemented. The application could be used by specialists in the field and also by non-technical persons. GreenLand offers the user possibilities to process default satellite images (that already exists in the application database and are available for all the users). Also the user could upload its own images that need to be processed. This process is in development phase.

It is worth to mention that the default images are accessible by all the users, but they cannot delete them. Downloading and the visualize them is the only permitted action.

2.2 Input and output dataset

At this moment the application works only with Landsat satellite images, organized in seven spectral bands. As mentioned before, there are already a couple of such images in the GreenLand database that could be used in the process workflow.

Fig.1 presents the default Lansat satellite images (e.g. romania1). Each of these images has seven spectral bands that are combined at the process run-time. Also a list of classification indexes is at the user discretion. These indexes perform different classifications, depending on the user needs.

Figure 1. Landsat satellite image data set

A process could have multiple input images, and for each image a certain number of vegetation indexes are allowed. Fig.2 shows a process that contains there Landsat satellite images, and for the second selected image a NDVI, EVI and IPVI vegetation indexes are applied.

If the check box bellow the vegetation index name is selected this means that the selected index is used in the process workflow.

Figure 2. Select input images and vegetation indexes

Before launching the process to execution on the Grid infrastructure, the user should associate a name and a description in order to facilitate the search action (Fig.3).

Figure 3. Process name and description

At the entire execution phase of the process, the user could analyze its status through the monitoring component (Fig.4).

Figure 4. Monitoring component

This component is personalized for each user, meaning that only the processes created by the current user are return by the search actions. Fig.4 shows that the current login username is testuser.

There are five search options for the user that will be presented in this paragraph:

a. **Search process by name**

Is the first search option, that allows the user to focus its' search on the name of the process. All processes that contain that name will be displayed in the table below. Fig.5 shows the search result for "test" process name.
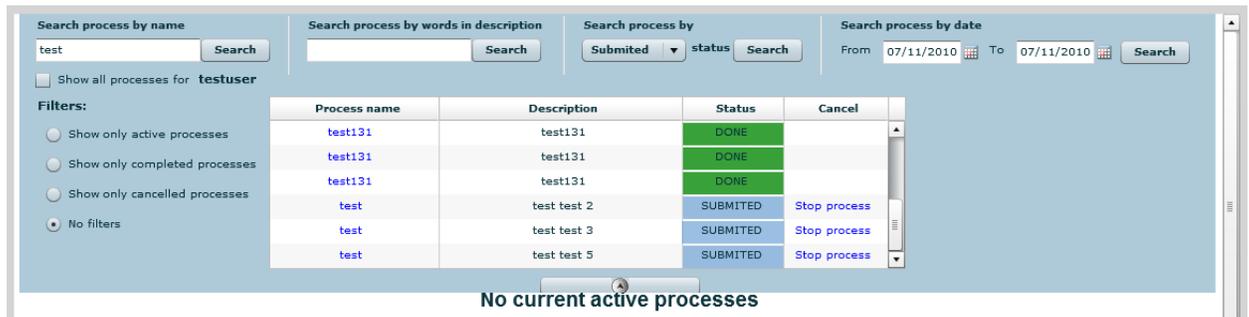

Figure 5. Search result for "test"

b. **Search process by words in description**

This search action is looking through the description of the process, and the results are placed in the same table as in Fig.5.

c. **Search process by status**

Every process has a status at a given moment of execution (e.g. submitted, running, done). This option allows the user to filter the current user process list and to display only those processes that have the same status.

d. **Search process by date**

Display all the processes that have the start time in the time interval specified through the calendar buttons.

e. **Show all processes for**

This is the most general search, meaning that all the processes for the current users will be displayed in the table presented in Fig.5.

There are three types of filters that could be applied for every search option presented above:

a. **Show only active processes**: limits the search results to the processes that are in SUBMITTED or RUNNING status;

b. **Show only completed processes**: only DONE status processes are displayed to the user;

c. **Show only cancelled processes**: refers to the processes in CANCEL status;

d. **No filters**: no filters are applied on the search result.

The search result table contains basic information about the process: name, description and status. Every row in the table has a different color based on the status of the process. The color meaning is the following:

- Red color: cancelled processes;

- Blue color: submitted processes;

- Orange color: running processes;

- Green color: done processes.

The user has the possibility the view the inputs and outputs for every process in the search result table by clicking on the process name, marked with blue. The effect of such an action is presented in Fig.6. At this moment the information about the execution of the clicked process is displayed in the following structure: the ID of the process, the inputs and the lower table contains the execution results.
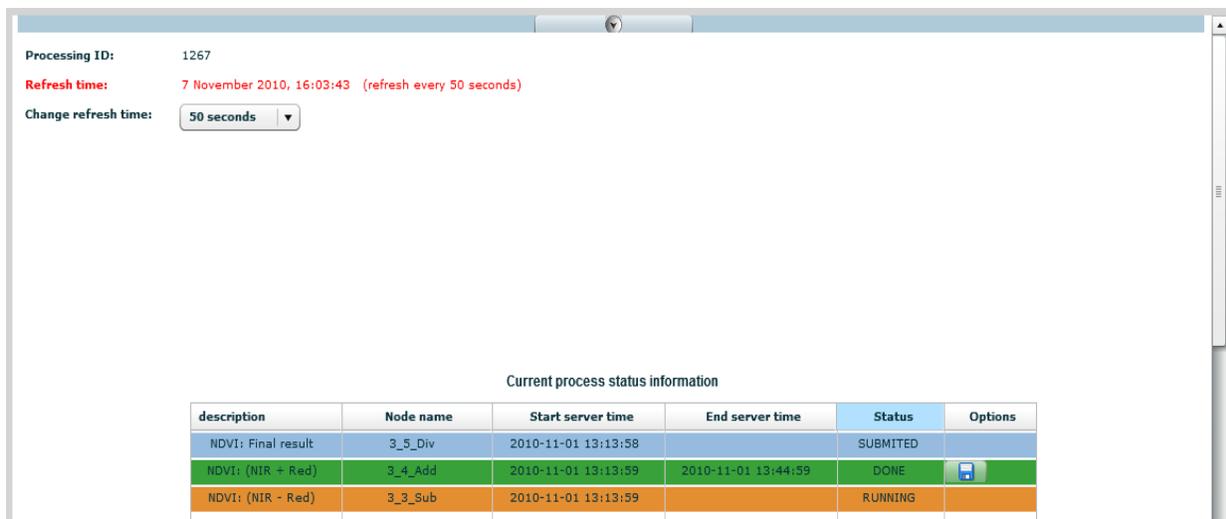

Processing ID:	1267
Refresh time:	7 November 2010, 16:03:43 (refresh every 50 seconds)
Change refresh time:	50 seconds

Current process status information

description	Node name	Start server time	End server time	Status	Options
NDVI: Final result	3_5_Div	2010-11-01 13:13:58		SUBMITED	
NDVI: (NIR + Red)	3_4_Add	2010-11-01 13:13:59	2010-11-01 13:44:59	DONE	💾
NDVI: (NIR - Red)	3_3_Sub	2010-11-01 13:13:59		RUNNING	

Figure 6. Monitor the process status

The **Current process status information** table contains information about the jobs of the process, like: name, description, start execution time, end execution time, status and an option attribute. This option attribute contains a download button, used for downloading the results.

Another important aspect is that the user can stop the execution of any process that he submitted, by clicking the **stop button** in the **Cancel** column of the search result table.

The output results are available in jpg format, where a color legend is used to classify the input images. These results could be downloaded by the user, after the Grid processing has completed with success.

2.3 Start a new processing on the Grid infrastructure

In this scenario we use only the default Landsat satellite images. First we have to select the input images and the vegetation indexes used in the classification process.

a. **Step 1** (input file selection)

Specify input satellite images and select for each image the vegetation indexes used in the process workflow. Fig.7 shows a possible input data set. This is only an example, meaning that the user could imagine its own scenario.

Check all	Image name	Options	NDVI	EVI	IPVI	SAVI	GEMI
✓	romania1	👁 💾 ✖	✓	✓	✓	☐	☐
☐	romania2	👁 💾 ✖	☐	☐	☐	☐	☐
☐	romania3	👁 💾 ✖	☐	☐	☐	☐	☐
☐	romania4	👁 💾 ✖	☐	☐	☐	☐	☐
☐	romania5	👁 💾 ✖	☐	☐	☐	☐	☐
☐	romania6	👁 💾 ✖	☐	☐	☐	☐	☐

Processing options

Figure 7. Input file selection

b. **Step 2** (naming the process)
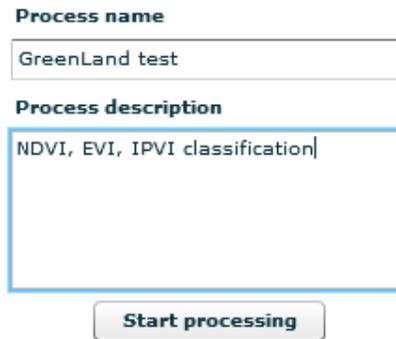
Figure 8. Naming the process

c. **Step 3** (execution monitor and result management)

After the process is launched over the Grid infrastructure, the user could monitor its status, using the monitoring component. Updates of the execution are displayed in the **Current process status information** table at every 30, 50 or 100 seconds, depending on the user needs.

3. Conclusions

This is only the beginning phase of the development process regarding GreenLand application. Adding new types of input satellite images (e.g. MODIS, MERIS, ASTER) is one of the next research direction. Also changing the human-computer interaction techniques or adding new ones represent one of the features that need to be taken into account. We could mention some of the possible interaction techniques, such as:

a. Overly the result on an interactive map, and simulate the evolution of natural phenomena in some geographical areas;
b. Using predefined color legend in order to classify the satellite images;
c. Online editing results: image zoom, rotate, create new color scheme, save these results locally or to the application server.