



Tutorial:

NDVI calculation with SPRING GIS

and satellite image download with the USGS GloVis portal

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This document is meant to be a simple guide for inexperienced users on how to carry out a basic GIS task with SPRING GIS, a program that is available for free. The user will learn how to download and use satellite images that are needed from the USGS GloVis website. It will be explained to the user how to import and visualize the data into SPRING GIS and how to calculate the NDVI (Normalized Difference Vegetation Index) in order to illustrate land cover changes and to monitor droughts.

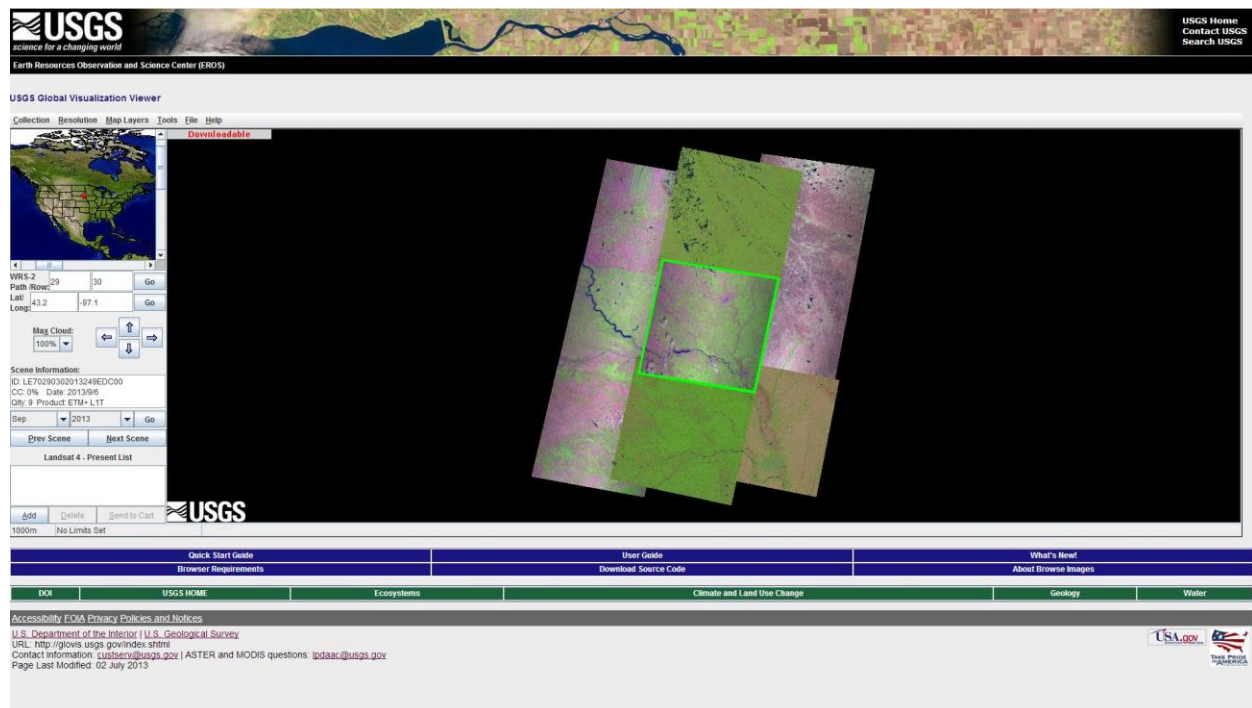
The UN Spider team put emphasis on the fact that the single steps are explained and implemented with pictures so that no prior knowledge of GIS and related software is required in order to get good results.

Downloading data from GloVis

At the beginning, satellite imagery data has to be downloaded from websites such as GloVis. It provides satellite images for free from various satellites such as Landsat or Modis and from different years.

-> Open your web browser and type <http://glovis.usgs.gov>

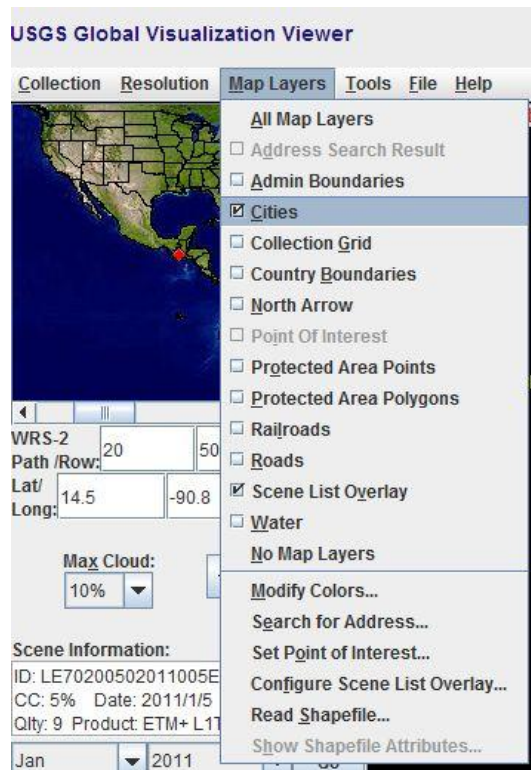
You need to have the free java software installed on your computer in order to run GloVis. Now you will see the main screen of GloVis. (Picture 1)



Picture 1

The main window in the centre contains the map and is split into several rectangular satellite images. The one that is selected is highlighted in green or yellow. In order to get a better sense of orientation, the button "cities" should be turned on.

-> map layers -> cities (Picture 2)



Picture 2

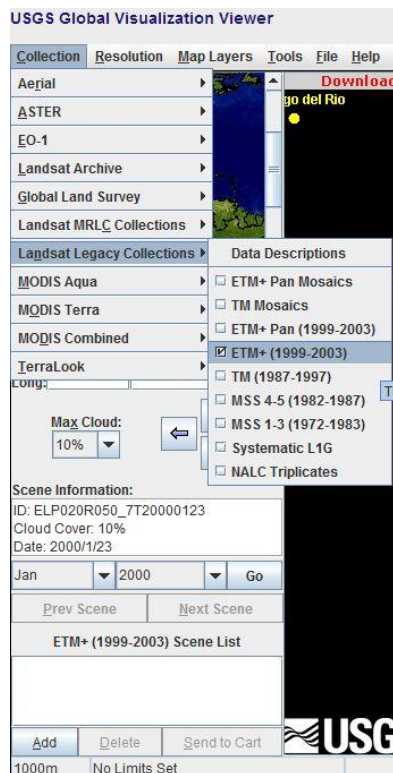
Now, larger cities are marked on the map in yellow. In this example, we use satellite data of Guatemala. To easily locate the country, please click on the small map in the upper left corner and navigate to Central America. Alternatively, you can type in for path “20” and for row “50”, this will directly show the respective area. (Picture 3)



Picture 3

In the next step, we select a satellite image to be displayed. Click on the “Collection” button and then “Landsat Legacy Collections” and choose “ETM+ (1999-2003)” in order to visualize data from Landsat ETM from the years 1999 to 2003.

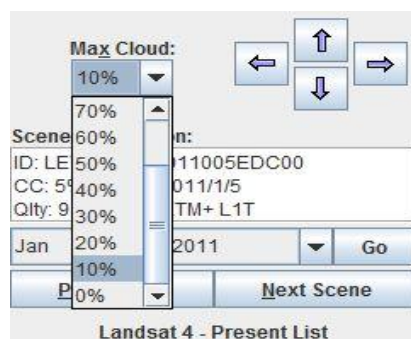
-> Collection -> Landsat Legacy Collections -> ETM+ (1999-2003) (Picture 4)



Picture 4

Next, we use the option “Max Cloud” to choose a low cloud cover in order to get a better quality image. In the drop down menu, we click on 10%. Observe that the month and year might change as not for every date an image with a 10% cloud cover is available.

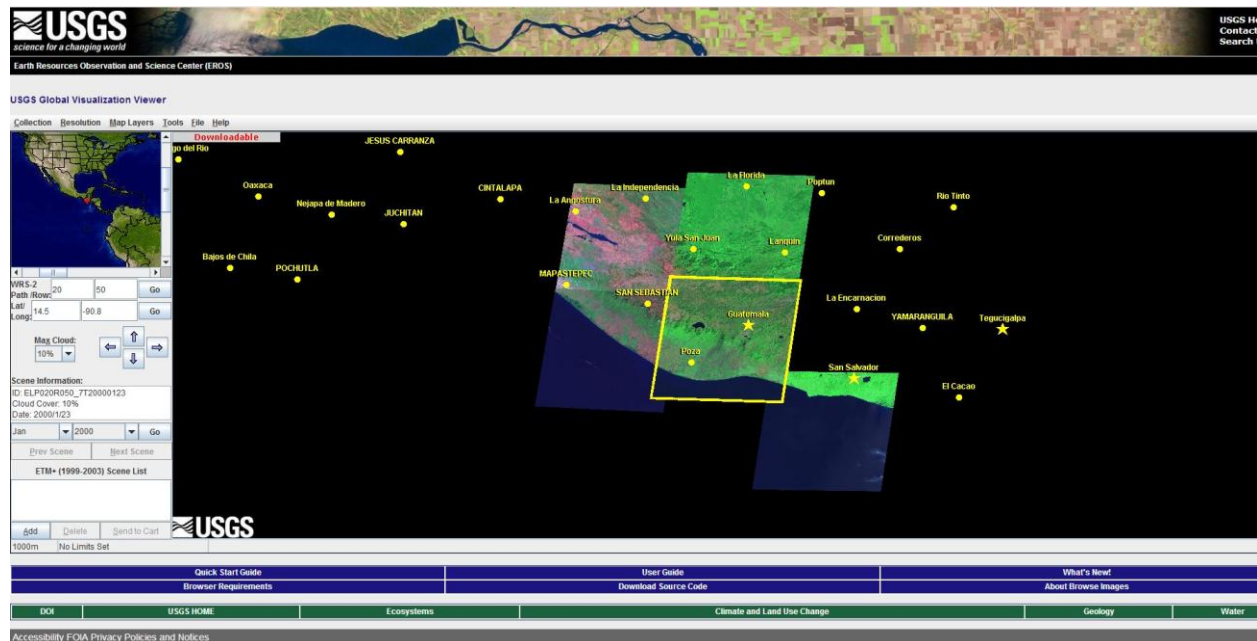
-> Max Cloud -> 10% (Picture 5)



Picture 5

After that we select the date we are interested in. In our example we use a satellite image from January 2000.

Your screen should now look similar to this: (Picture 6)

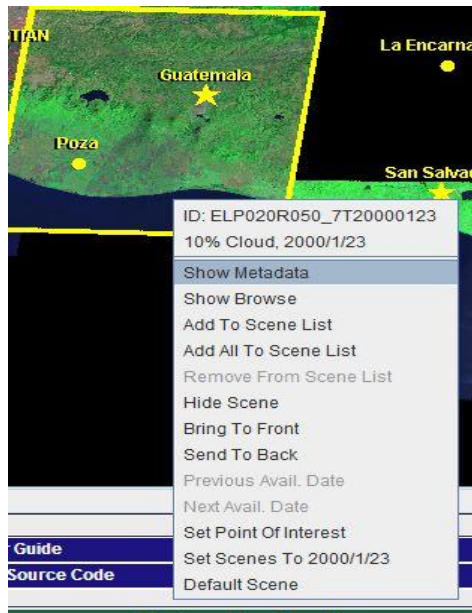


Picture 6

The city names are displayed, the date is changed to January 2000 and the image of row 20 and path 50 is selected and highlighted in yellow.

If you want to get a list of the metadata, including projection type or coordinates, do a right-click on the image that is highlighted with a yellow rectangular square and choose metadata.

-> Show Metadata (Picture 7)



Picture 7

The next step is to download the data through clicking on the button “add” in the user interface on the left. -> Add (Picture 8)

Scene Information:			
ID: ELP020R050_7T20000123			
Cloud Cover: 10%			
Date: 2000/1/23			
Jan	▼	2000	▼ Go
Prev Scene		Next Scene	
ETM+ (1999-2003) Scene List			

Add	Delete	Send to Cart
1000m	No Limits Set	

Picture 8

Now your Landsat satellite image is added to the box and you should click on “Send to Cart”, which opens a new window.

-> Send to Cart (Picture 9)

Scene Information:		
ID: ELP020R050_7T20000123		
Cloud Cover: 10%		
Date: 2000/1/23		
Jan	▼	2000 ▼ Go
Prev Scene		Next Scene
ETM+ (1999-2003) Scene List		
ELP020R050_7T20000123		
Add	Delete	Send to Cart
1000m	No Limits Set	

Picture 9

However, you need an account in order to download the satellite data. If you don't have one yet, you need to register. But that's a fast and simple process. (Picture 10)

https://earthexplorer.usgs.gov/login/?RET_ADDR=http%3A%2F%2Fearthexplorer.usgs.gov%2Forder%2Fprocess%31

USGS
science for a changing world

EarthExplorer

Home Register Feedback Help

You must sign in as a registered user to download data or place orders for USGS EROS products.

Sign in using your USGS registered username and password

Username:

Password:

Remember Me ☐

Cancel Sign In

[Forgot your password?](#)

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URL: <https://earthexplorer.usgs.gov>
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USA.gov
Government. State. Easy.

TAKE PRIDE IN AMERICA

Picture 10

After signing in successfully, you will see your item basket with the data that was just added. (Picture 11)

Item Basket

[Home](#)
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[Logout dominikspider](#)
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No scenes were automatically added to your item basket. Please select the appropriate order type for each scene and click 'Apply'.



Pending Scenes

Entity Id	Collection	Order	Bulk Download	Available Products
ELP020R050_7T20000123	ETM+ (1999-2003)	<input type="checkbox"/>	<input type="checkbox"/>	Bulk Products Standard Format

[Toggle All Bulk Download](#)
[Apply](#)
[Go to Item Basket](#)

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[Privacy](#)
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U.S. Department of the Interior U.S. Geological Survey
URL: <https://earthexplorer.usgs.gov>
Page Contact Information: its@usgs.gov
Page Last Modified: 09/04/2013

Picture 11

Now click on the button under “Bulk Download” and then on “Apply”.

-> Bulk Download -> Apply (Picture 11).

Afterwards the view will change to “Bulk Download” and you can select the data sets that you would like to use. Here is just the “Standard Format” available. In other data sets for example, there are also small data size Landsat Look images available in jpeg format. But they are not suitable for our NDVI calculation. So we always have to select and download the larger Level 1 Product file or in our case the Standard Format.

-> Proceed To Checkout (Picture 12)

EarthExplorer

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[Help](#)

Please Note: This page will expire at 10:04:21 AM CDT. Once expired, you will be logged out and your order may be lost.

Bulk Download [Clear All](#)

Note: Data sets may contain items with multiple product options. Expand a data set to view your list of ordered scenes including metadata and product options.

^ ETM+ (1999-2003) (1)
Remove All Scenes Modify Options For All Scenes



ELP020R050_7T20000123

Entity ID: ELP020R050_7T20000123
Acquisition Date: 23-JAN-00
Path: 20
Row: 50
Product: Standard Format (283.5 MB)

[Save Changes](#)
[Proceed To Checkout »](#)

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Picture 12

The next screen shows the selected data and its size. Simply click on “Submit Order”.

-> Submit Order (Picture 13)

EarthExplorer

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Please Note: This page will expire at 10:08:07 AM CDT. Once expired, you will be logged out and your order may be lost.

Bulk Download



Note: File sizes are approximate. Final file size may vary slightly.

Data Set	Qty.	Products	File Size
ETM+ (1999-2003)	1	1	283.5 MB
Total Size:			283.5 MB

[Return To Item Basket](#) [Submit Order](#)

[Accessibility](#) [FOIA](#) [Privacy](#) [Policies and Notices](#) [Google Maps API Disclaimer](#)

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URL: <https://earthexplorer.usgs.gov>
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Picture 13

Now, we have to wait a while till we can use the satellite imagery. Sometimes it will take several hours for the data to be available for download. The “Bulk Download” window provides information on how to proceed. You will be notified through email when the data is ready for download. For downloading you need the Bulk Download Application that can be installed through clicking on the link that is highlighted in the text. (Picture 14)

EarthExplorer

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Bulk Download

Your Bulk Download order number 211059 has been received. A notification has also been sent to the email provided in your USGS Registration profile. **To begin the download process, the [Bulk Download Application \(BDA\)](#) is required. First time users: please download, install and open the BDA. Returning users: please open the BDA installed on your system.** You will be required to login using the EarthExplorer username and password used to complete your download request. Information and installation links can also be found at <https://earthexplorer.usgs.gov/bulk/help/>

If your order is Available, highlight the order number and click Select Order. On the next page, navigate to the download destination, make changes as you see fit for your system, highlight the first item in the list, and click Begin Download. When all items are downloaded you can select another order or close the window. The system will also keep track of failed downloads and retry them.

Bulk download orders are available for two weeks, after which the they are removed. You will need to place a new order to obtain data products if you do not download them from original order.

Entity ID	Product Description	File Size
ELP020R050_7T20000123	Standard Format	283.5 MB



Totals

Total File Size: 283.5 MB

[Return To EarthExplorer](#)

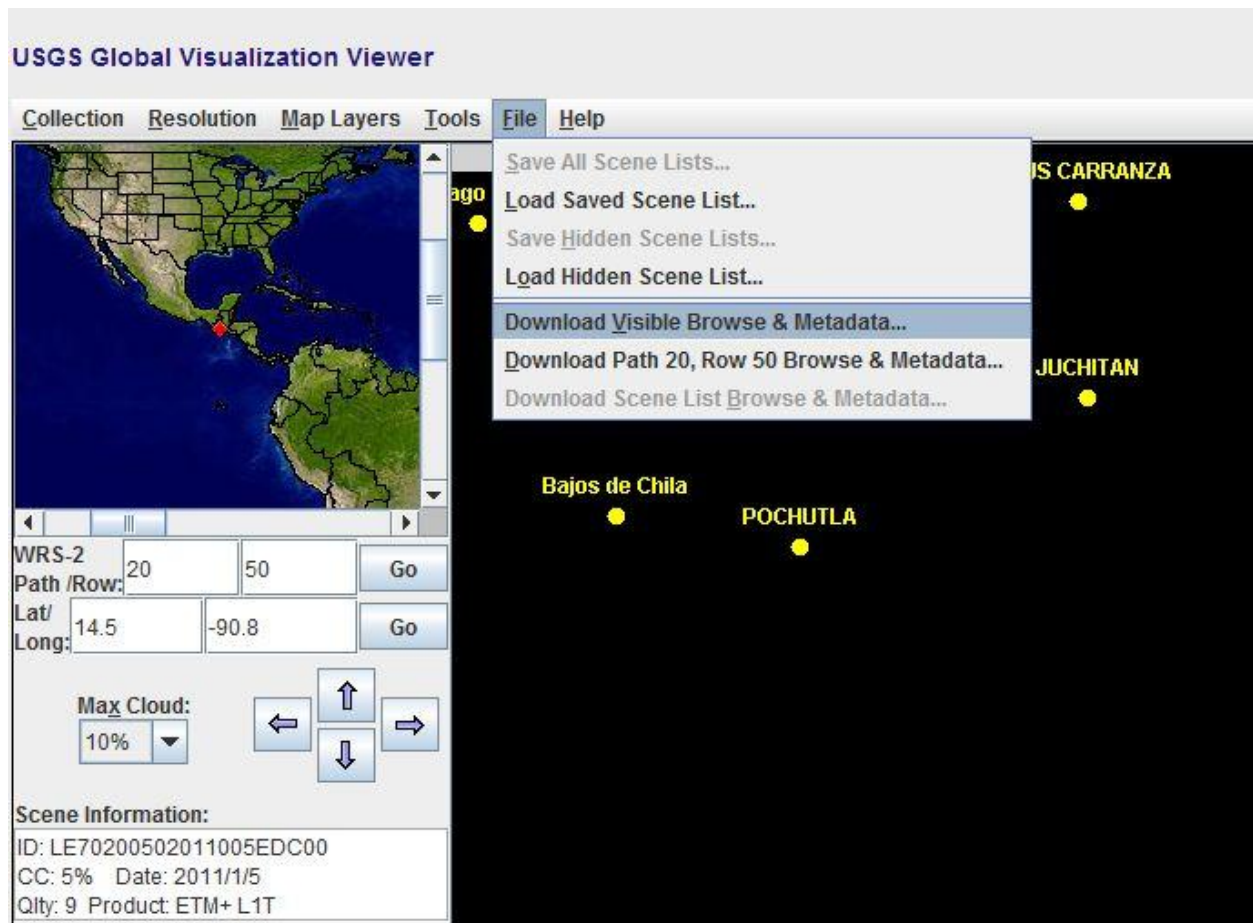
[Accessibility](#) [FOIA](#) [Privacy](#) [Policies and Notices](#) [Google Maps API Disclaimer](#)

[U.S. Department of the Interior U.S. Geological Survey](#)
URL: <https://earthexplorer.usgs.gov>
Page Contact Information: its@usgs.gov
Page Last Modified: 09/04/2013



Picture 14

Another way to get data is to click on the “File” button in the main menu and then on “Download Visible Browse and Metadata”. But this will just download data in the jpeg format and is not suitable for image processing or calculating the NDVI. It might just serve for visualization purposes. (Picture 15)

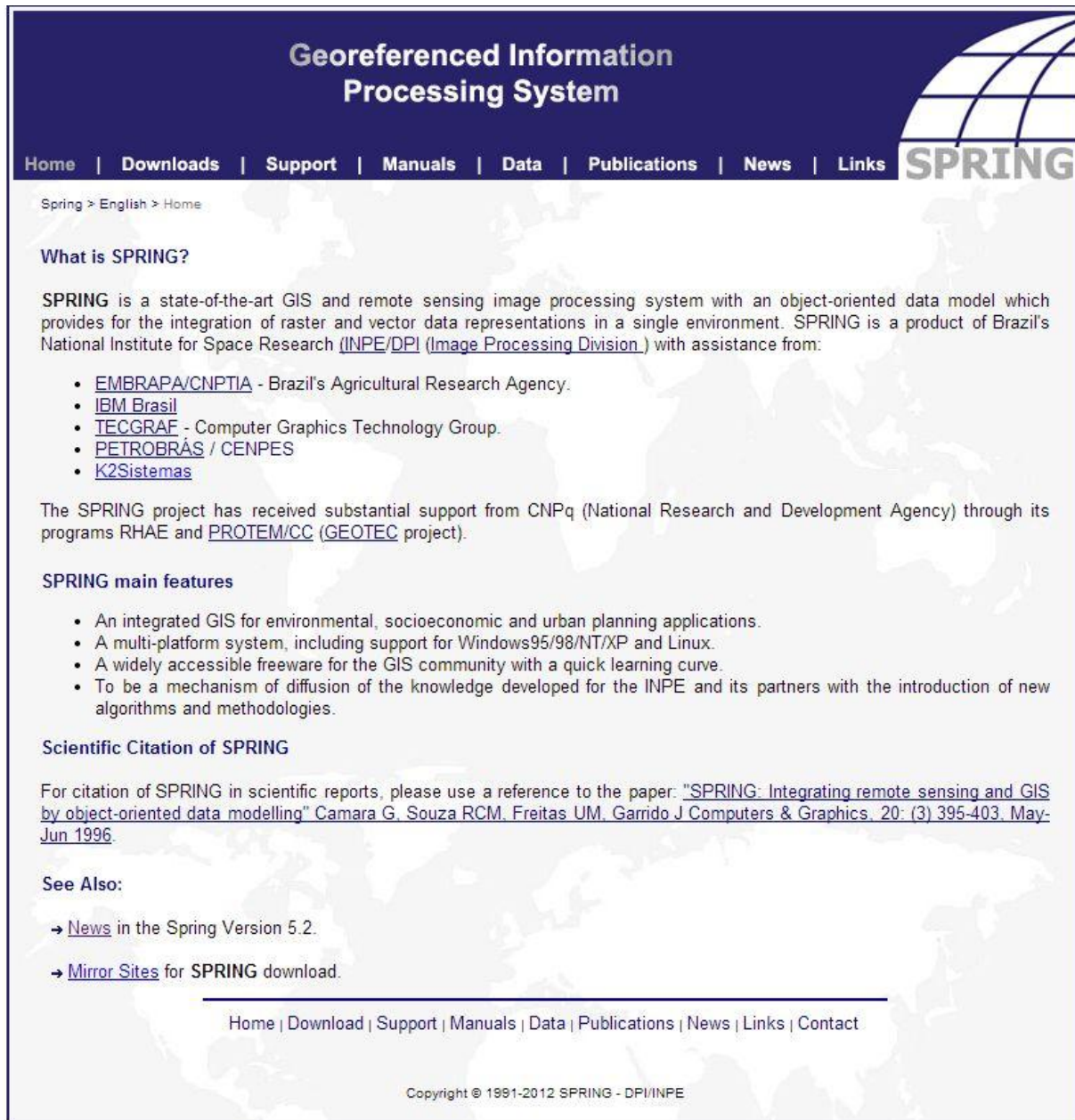


Picture 15

But once our data request is available for download (check your email account or the Bulk Download Application), we got everything we need to get started with SPRING GIS.

Using SPRING GIS

Now we have to download Spring GIS, a free GIS program that is developed in Brazil. First of all, type <http://www.dpi.inpe.br/spring/> in your web browser to open their website. Then please select "English". Your screen will look like this. (Picture 16)



Picture 16

Click on the button "Downloads" in the upper left corner.

In the download section you will see the system requirements of SPRING GIS. It can be used on Windows and Linux and older computers in general, as the system requirements are quite low. If clicking on the “Manuals” button, you will be able to download different Tutorials offered by SPRING. This might be helpful if you want to go further into the usage of SPRING GIS. (Picture 17)

Download

Home | Downloads | Support | Manuals | Data | Publications | News | Links **SPRING**

Spring > English > Download

DOWNLOAD

You need to be a registered user to download SPRING. The users are identified by their e-mail addresses. If you want to download SPRING and you are a registered user, just fill out your e-mail address and click the button "Download". If you are NOT a registered user, click the button "Subscribe". If you have forgotten your password, fill the e-mail field below and press the "Forgot Password" button. You will receive an e-mail with the password that is registered in our database.

E-mail:

Password:

Version:

SPRING on the Internet

With the purpose to widely spread the Geoprocessing and Remote Sensing techniques, the Linux and Windows 95/98/NT/ME/2000/XP/Vista/7 versions of the software SPRING, can be downloaded freely ("freeware") through the Internet. The Internet version is complete containing all functions developed by INPE/DPI with no limits of data size or processing time. SPRING is available as freeware, which means that you can freely copy and redistribute the system, but INPE retains the copyright. You are not allowed to modify, sell or lend the software, and you must redistribute the entire program. Being freeware, the code is supplied "as is", without warranty of any kind. Please, check the [license conditions](#) for more details. Click [HERE](#) if you want to download some examples of SPRING databases.

Requirements to run SPRING

SPRING runs either on Linux or Windows system. The minimum requirements for running on Windows are:

- An IBM-PC compatible, at least 512 Mb RAM, processor speed 500 MHz or better
- Hard disk: 200 MB for the software and 250 MB for examples;
- Windows 95/98/ME/NT/XP/Vista/7.

The requirements for Linux are:

- Memory (RAM): 512Mb or more.
- Hard disk: 200 MB free for the software and 250 Mb or more for examples.
- Linux Operational Systems: Fedora8, Mandriva2008, OpenSuse10/11 and Ubuntu7/8

Scientific Citation of SPRING

For citation of SPRING in scientific reports, please use a reference to the paper:
"SPRING: Integrating remote sensing and GIS by object-oriented data modelling" Camara G. Souza RCM. Freitas UM. Garrido J Computers & Graphics, 20: (3) 395-403. May-Jun 1996.

Picture 17

You are asked to subscribe through giving your email address in order to download the program. Type in your email address and password and select the version of Spring that you want to use, then click on subscribe. (Picture 18)

E-mail:

Password:

Version:

[Download](#) [Subscribe](#) [Change Data](#) [Forgot Password](#)

Picture 18

Now you will be directed to the download section where you can choose which language SPRING shall be using. You can also choose from which source you want it to be downloaded, but we recommend to choose the first one. In our guide we are using the English version so please select the English one and click on “Install Complete” in the first section from “DPI – INPE – BRAZIL”. (Picture 19)

-> Install Complete (English)

WELCOME! Here you can download SPRING 5.2.4 32Bits for WINDOWS

SPRING WIN environment is composed by the following programs:

- **Spring** contains Geoprocessing and Image Processing functions.
- **Scarta** is used for interactive map production application.
- **Impima** is used for converting satellite images, or part of them, to the SPG image format.

→ Check the improvements of this new version at [News](#).

Choose the Site for downloading

SPRING 5.2.4 WINDOWS 32Bits

Source	Portuguese	Spanish	English	French
DPI - INPE - Brazil 	LEIAME	LEAME	README	LUME
	Instala Completo	Instalacion Completa	Install Complete	Installation Complet
	Banco Demo	Banco Demo	Database Demo	Base de données D�mo
	Instala Simbolos em BMP	Instalacion Simbolos em BMP	Symbol Installation - BMP	Installation de symboles BMP
Spain 	LEIAME	LEAME	README	LUME
	Instala Completo	Instalacion Completa	Install complete	Installation complet
	Banco Demo	Banco Demo	DataBase Demo	Base de donn�es D�mo
	Instala Simbolos em BMP	Instalacion Simbolos - BMP	Symbol installation - BMP	Installation de symboles - BMP
France 	LEIAME	LEAME	README	LUME
	Instala Completo	Instalacion Completa	Install complete	Installation Complet
	Banco Demo	Banco Demo	Database Demo	Base de donn�es D�mo
	Instala Simbolos em BMP	Instalacion Simbolos - BMP	Symbol installation - BMP	Installation de symboles - BMP

Picture 19

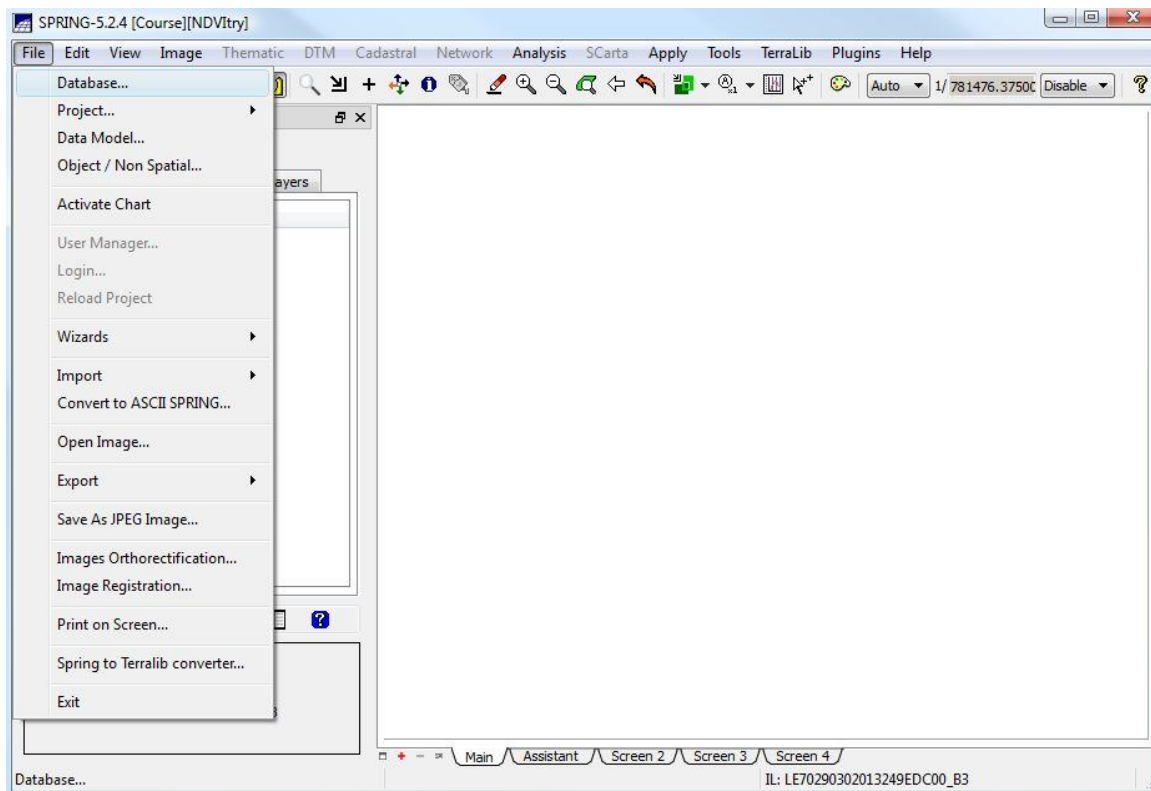
By now the file of around 105MB is downloading. When finished go through the installation setup and install the software. (Picture 20)



Picture 20

Now you have SPRING GIS installed and we are ready to proceed with working on our data that we downloaded from GloVis earlier. To start, please open SPRING GIS. We basically have to follow three steps which include creating a database, then a project and finally a data model. In the beginning we need to create a new database. The database is one of the main functions in SPRING GIS and is important, because without we cannot really work on data. In the upper left corner we click on file and then on database. (Picture 21)

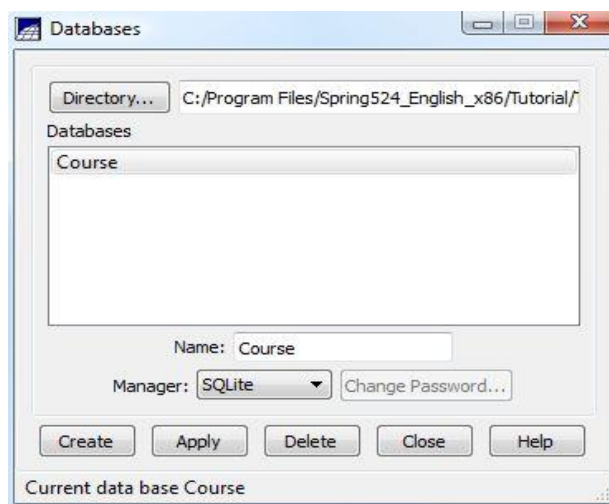
-> File -> Database



Picture 21

In the new window we click on the button “directory” and select or create a folder we want to work in. Then we give our database a name, such as “course”. To do so type in “course” just next to name and click “create”. Now our new database appears as “course”. Finally, we click on “apply”. (Picture 22)

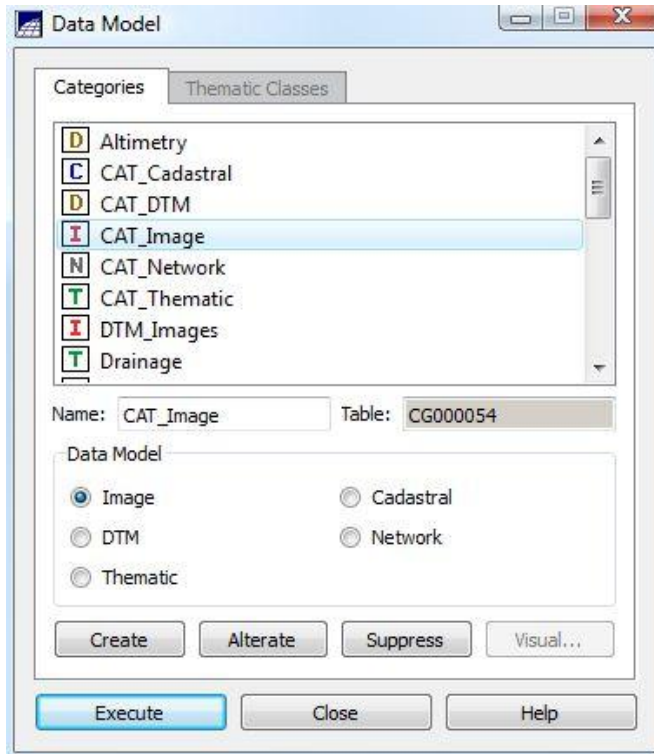
-> Directory -> name -> create -> apply



Picture 22

The next step is to define/ create a data model in the active database before we can import any data into SPRING. Click on the “file” button and then select “data model”. After that choose “CAT_Image” and click on “Execute” which finishes the second step.

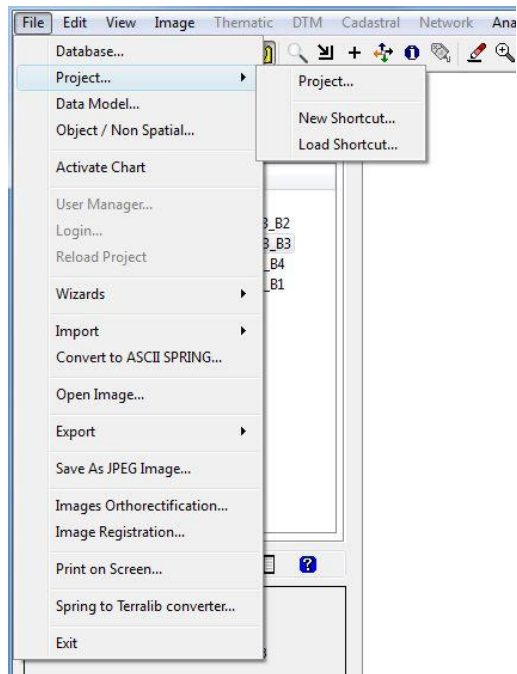
-> File -> data model -> CAT_Image -> Execute (Picture 23)



Picture 23

The last step is to create a “project” that is basically your working platform. You can have various projects created, but just one can be active at a time. The project will contain several “Information Layers (IL). Please click on the “File” button again and then on “Project” and on the other “Project” button as well.

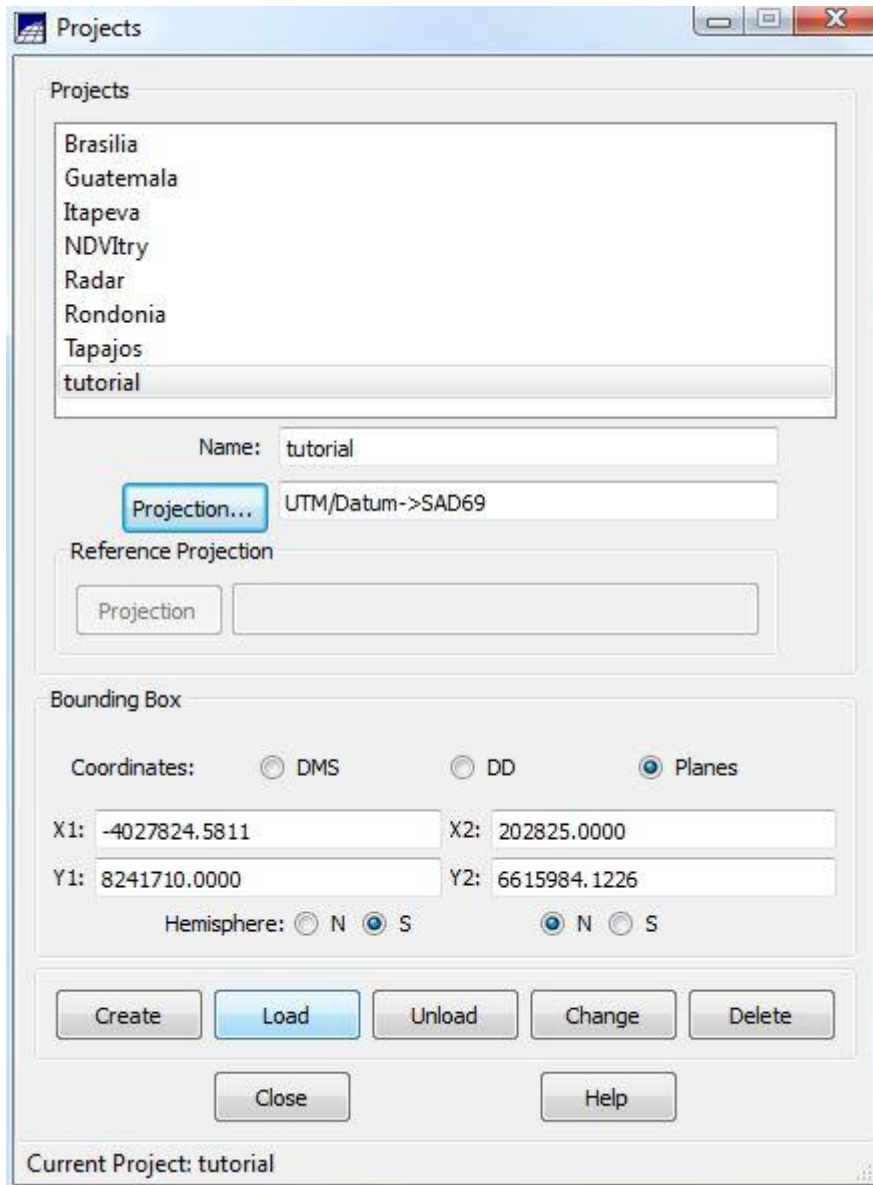
-> File -> Project -> Project (Picture 24)



Picture 24

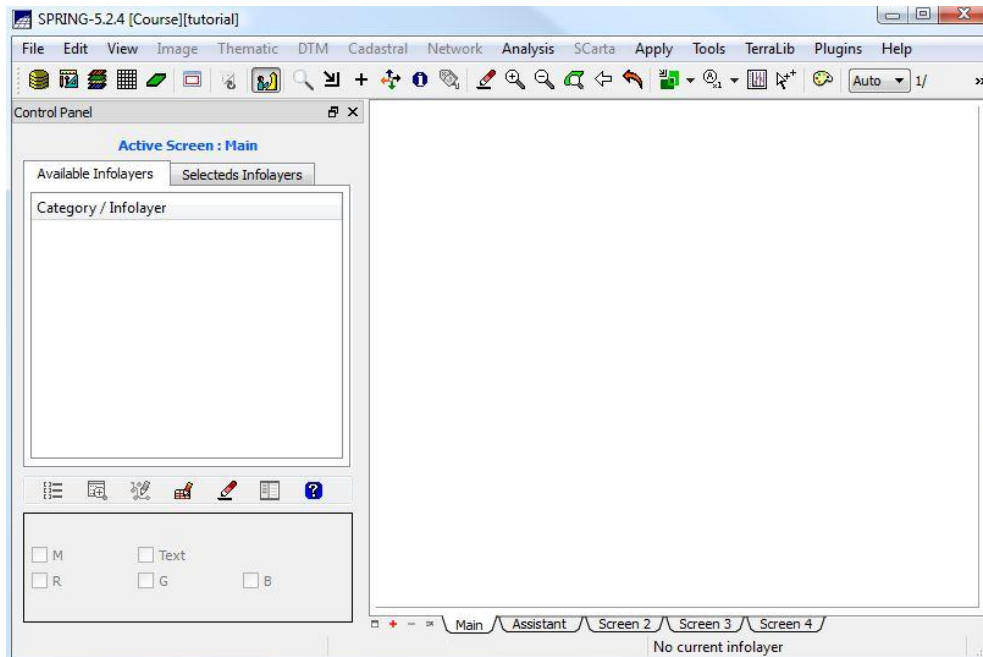
In the new window that just opened we name our project for example to “tutorial”. Then we have to select a projection. Because the data we downloaded is about Central America, we select UTM/Datum “SAD69”. Afterwards we click on “Create” and then “Load” at the bottom of the window.

-> Name -> Projection -> UTM/Datum SAD69 -> Create -> Load (Picture 25)



Picture 25

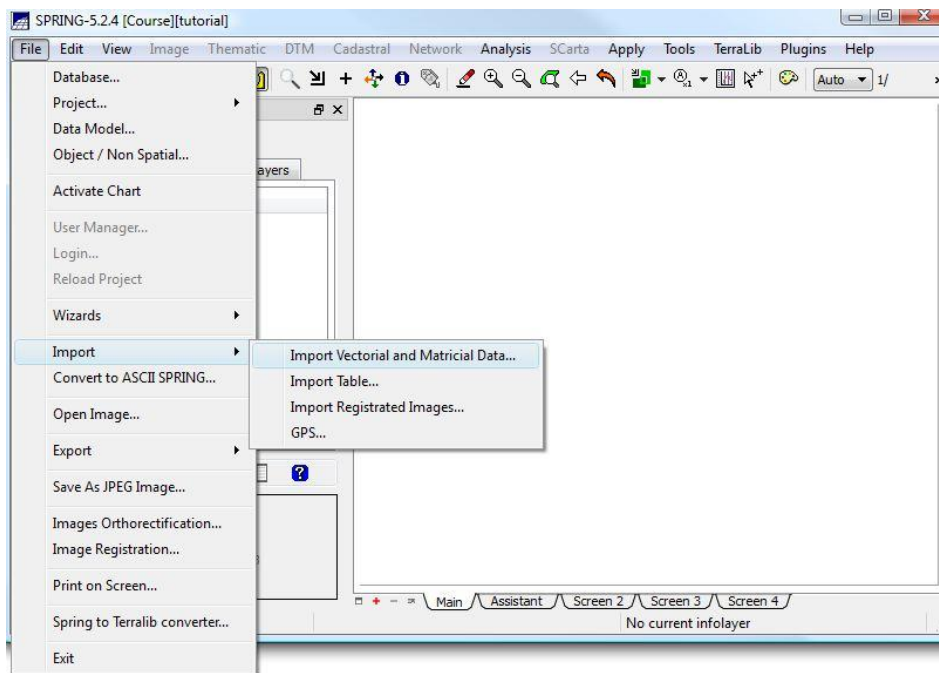
Finally we have set up everything we need to start working with our satellite imagery data. SPRING GIS should look very blank now. The software might look quite complicated at first but for our task we do not need to use every function and can concentrate on the most important ones. (Picture 26)



Picture 26

To import our data, please click on the “File” tab and then select “Import” and “Import Vectorial and Matricial Data”

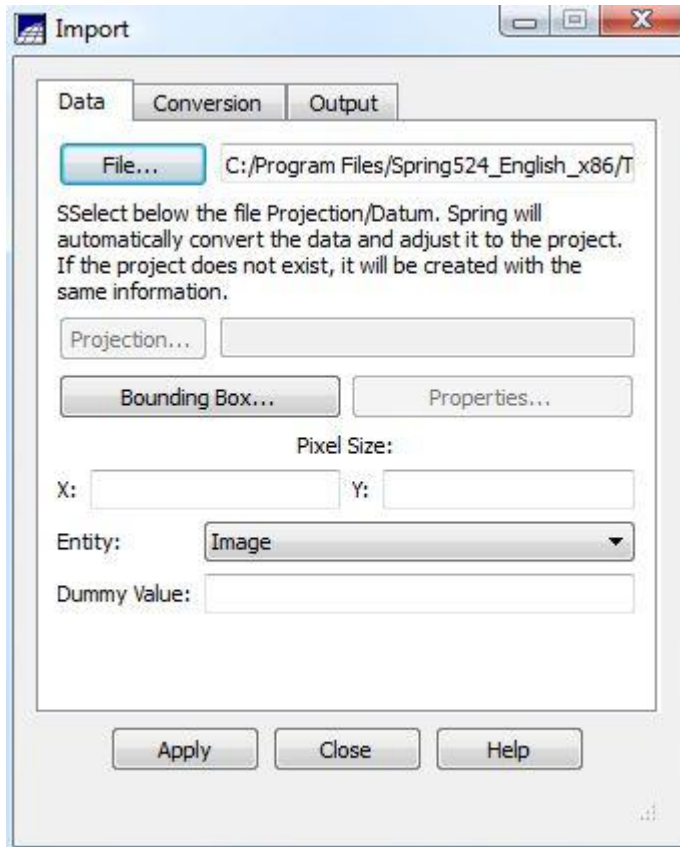
-> File -> Import -> Import Vectorial and Matricial Data (Picture 27)



Picture 27

Now the “Import” window will be open. Click on “File” and look for the folder in which you saved the satellite data from GloVis.

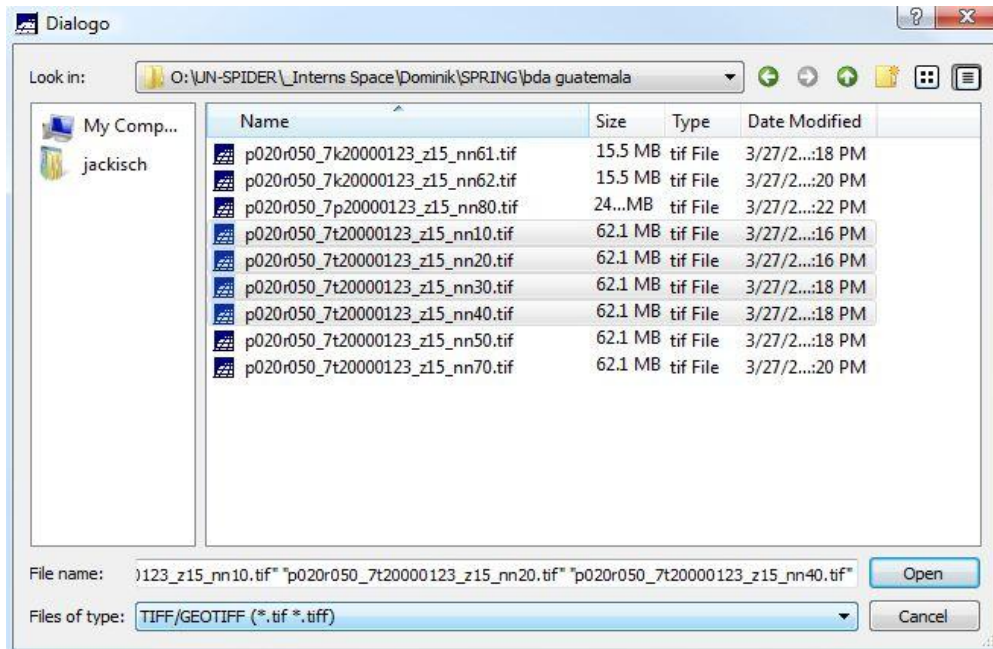
-> File (Picture 28)



Picture 28

You should change the “files of type” to “Tiff/GEOTIFF” because our downloaded data is saved in this format and we might not find it otherwise.

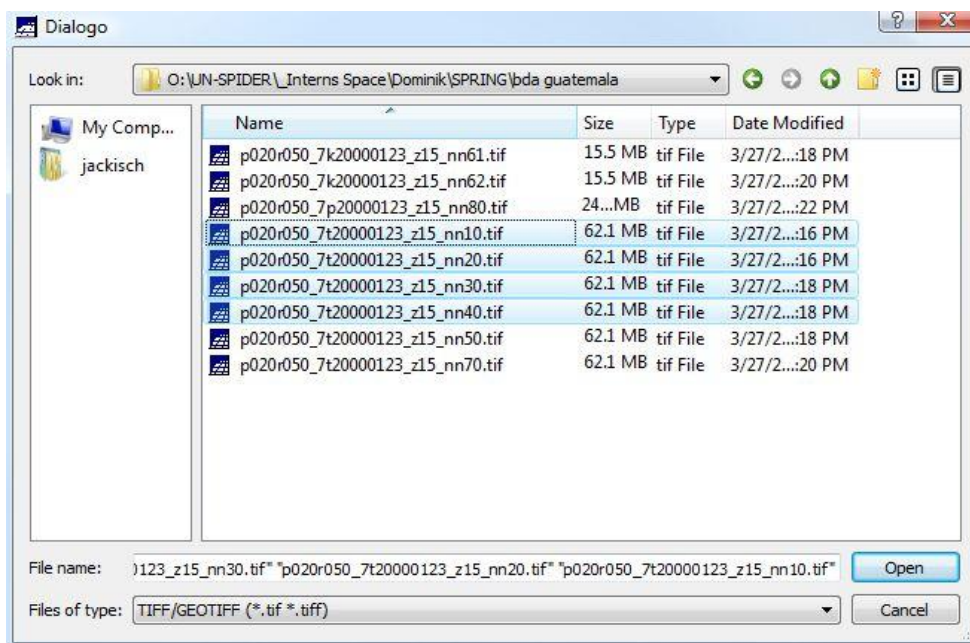
-> Files of Type -> TIFF/GEOTIFF (Picture 29)



Picture 29

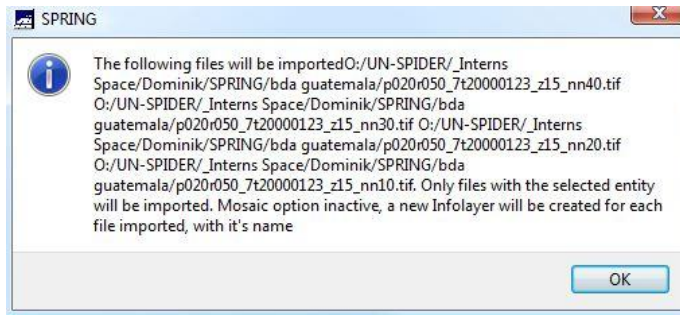
Here we can see the different Landsat bands listed. For our task we just need the four bands, nn10.tif to nn40.tif. Please select them through pressing “Ctrl” on the keyboard and clicking on them. Then choose “Open” and after that “Apply”. The bands will be loaded into SPRING. This may take several minutes.

->nn10.tif – nn40.tif -> Open -> Apply (Picture 30)



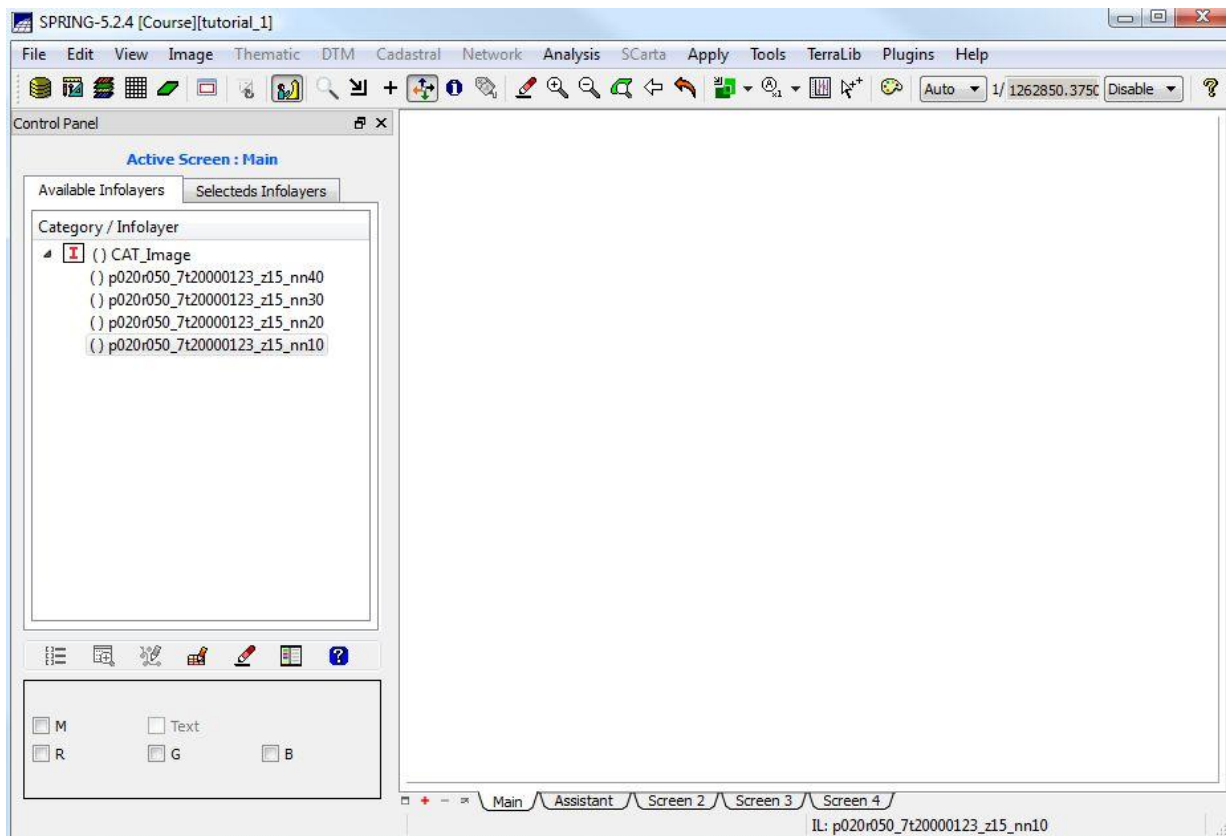
Picture 30

A new window will pop up, just click on “OK”. (Picture 31)



Picture 31

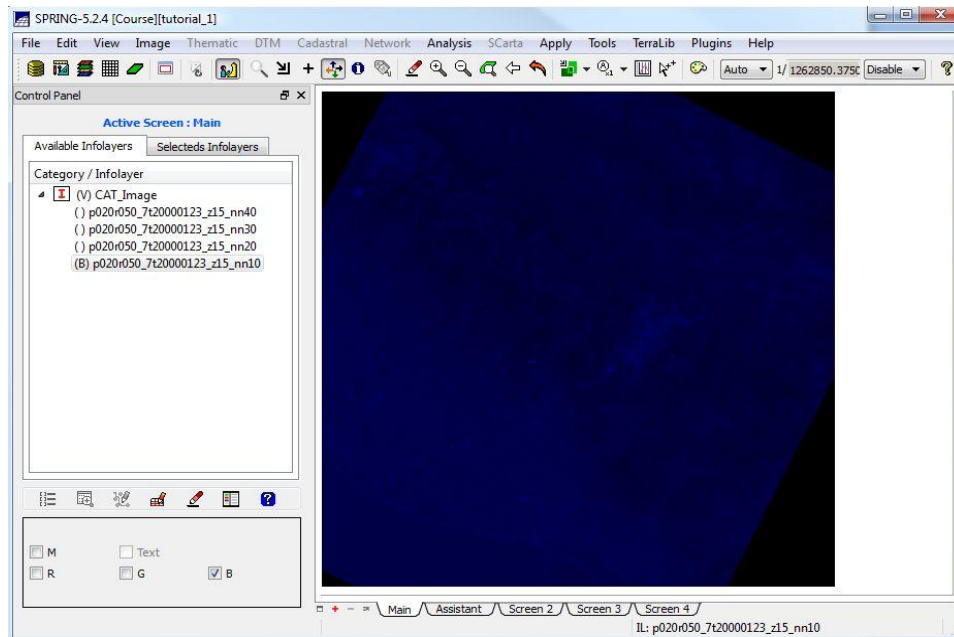
When the data is finally loaded you will see the new Information Layers appearing on the left. (Picture 32)



Picture 32

Once the data is imported we can almost start calculating the NDVI. If you click on any Information Layer you will be shown the different options. G stands for green, B for blue and R for red. In order to create a

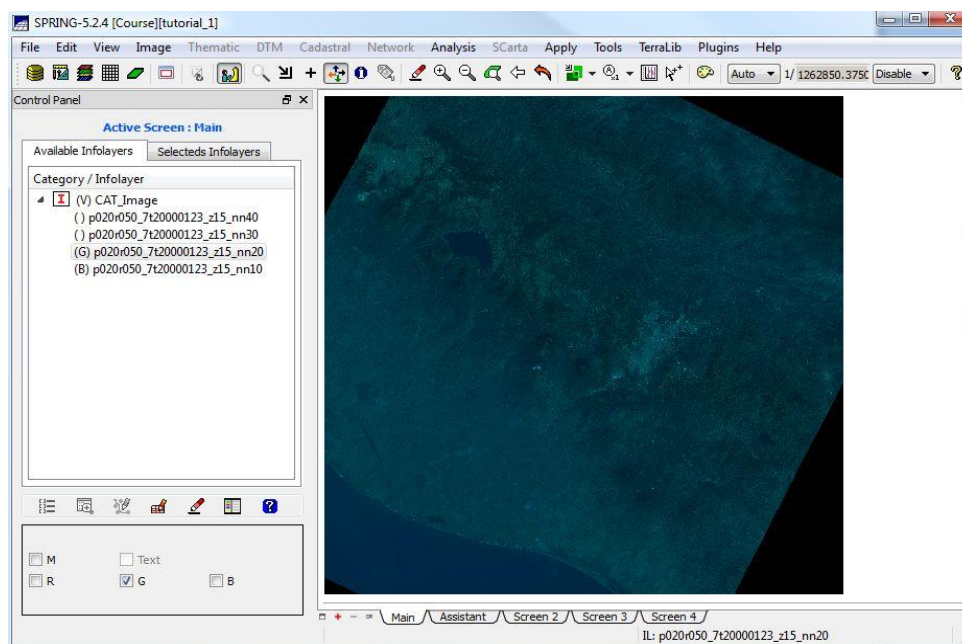
natural color image we simply select the respective bands with the appropriate color. For the first band we select B, for the second one G and for the last band R. The first band is nn10. (Picture 33)



Picture 33

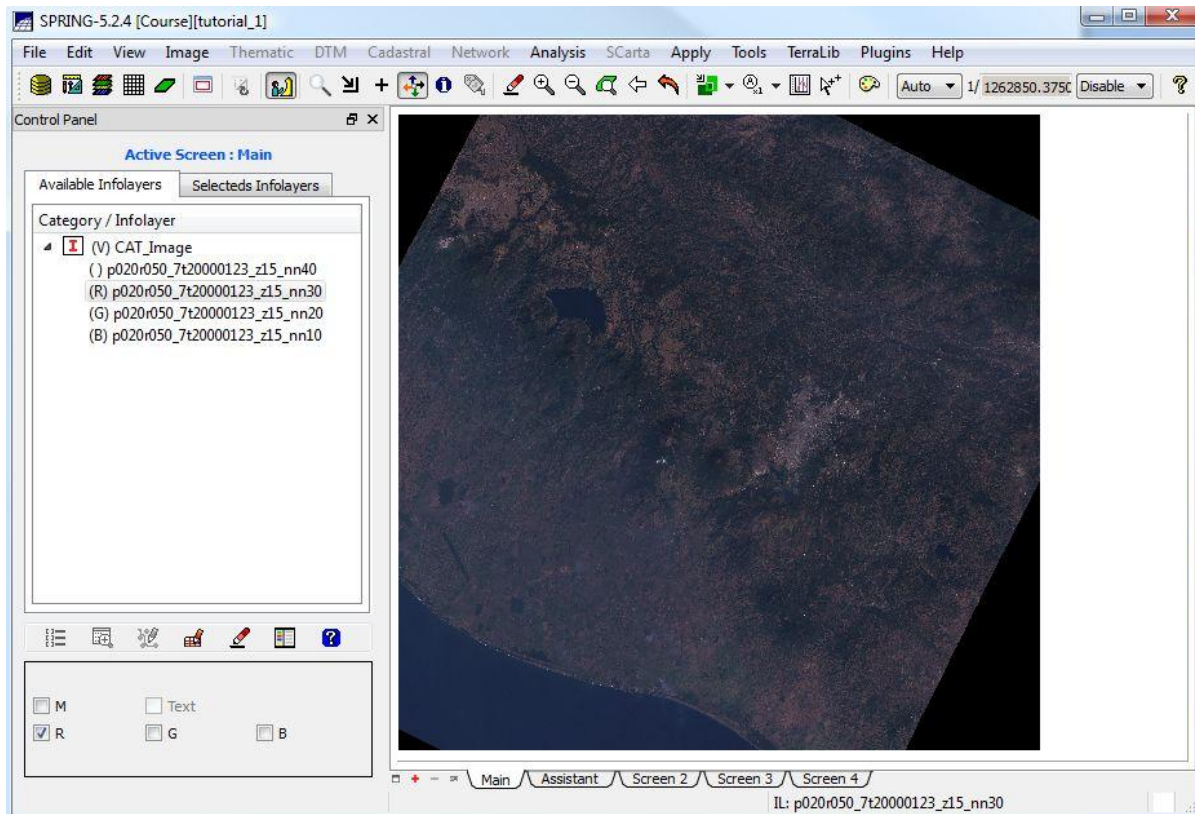
The band nn10 is activated and a “B” is written at the front. We are also shown a blue image, but it is hard to recognize anything on it.

Now select G for the nn20 one. (Picture 34)



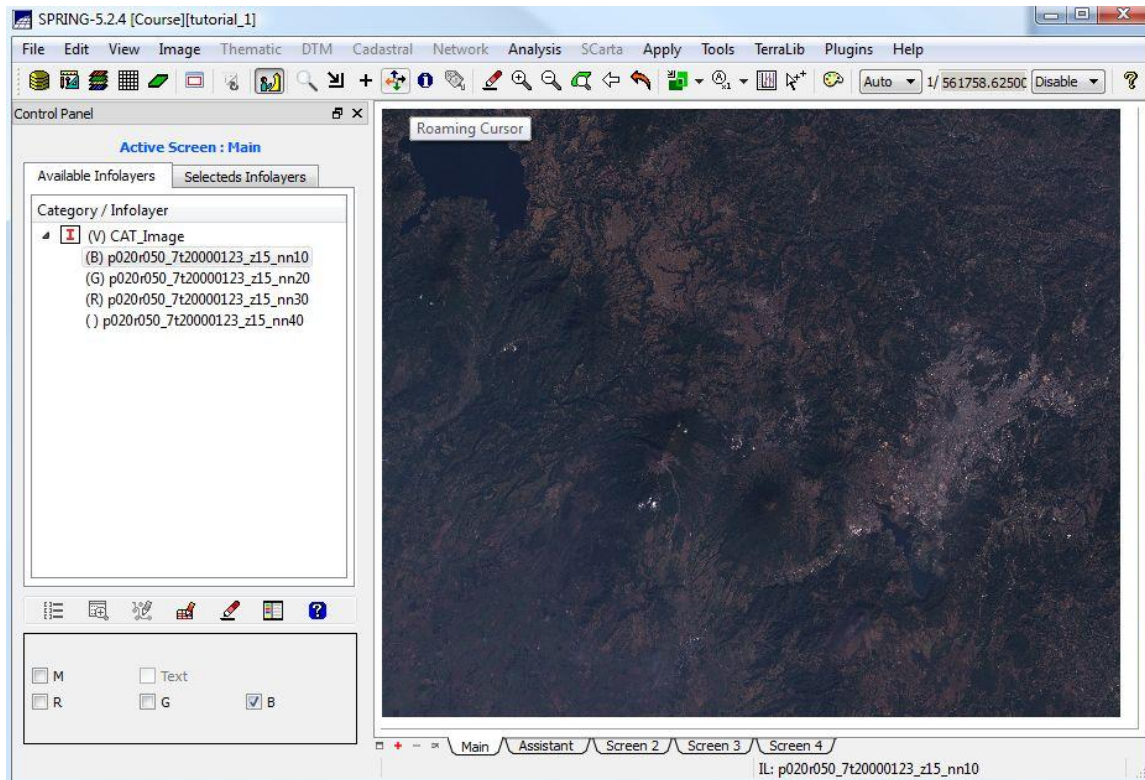
Picture 34

After that we select the nn30 band and click R for red. Our satellite image is now a natural color one and should look more familiar to us. (Picture 35)



Picture 35

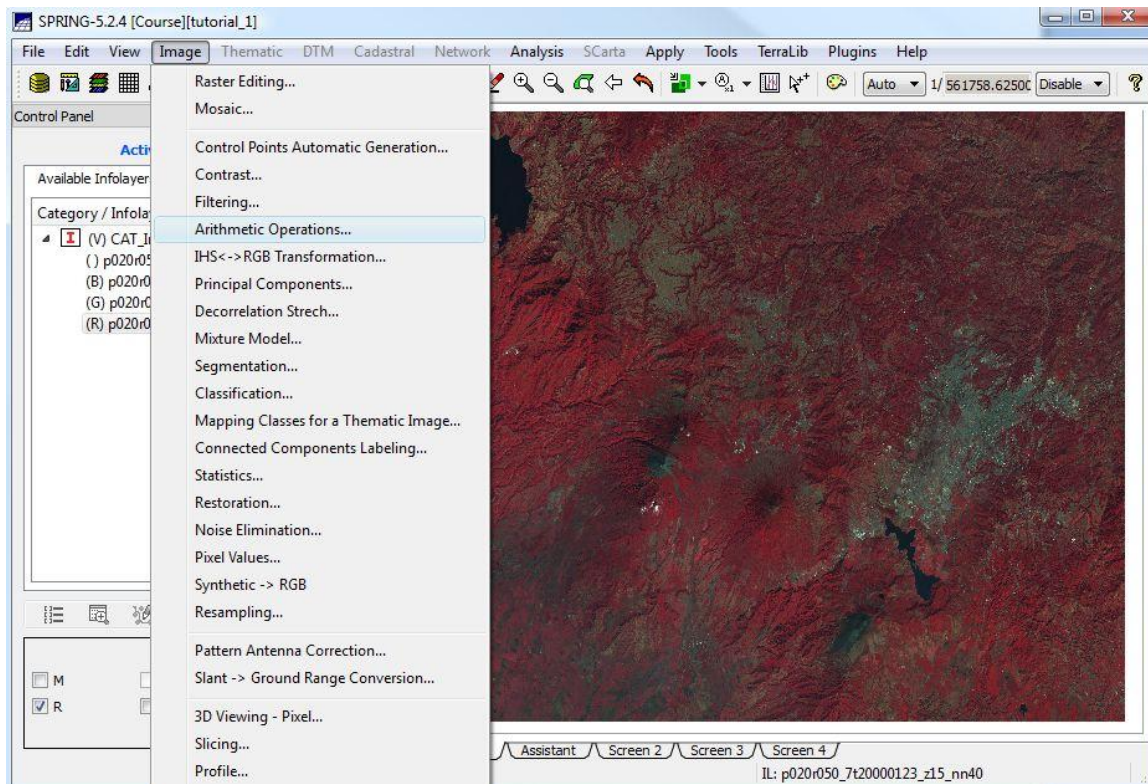
So now Spring GIS shows the natural color image. You might have to zoom in a bit to get a closer look at the image. The two buttons for doing so are at the top. With the "Roaming Cursor" you can change your view and move the image and with the "Magnifier" button next to it on the right you can zoom in. The red arrow "Reset" zooms out to a full extent. (Picture 36)



Picture 36

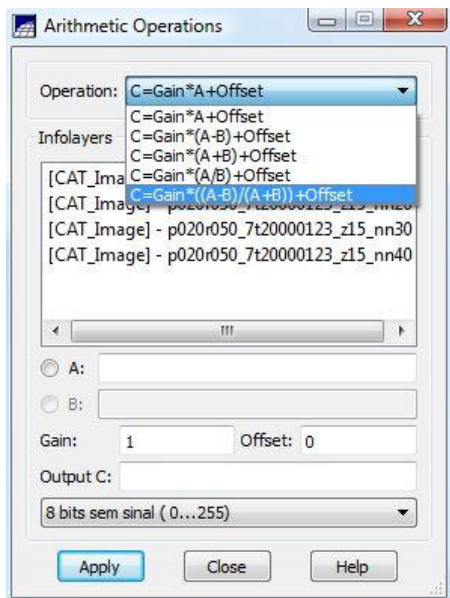
On the upper left corner of the image you are able to see the lake “Lago de Atitlan” and on the left side there is Guatemala City visible.

You can simply try out other band combinations like creating a false color image. To do that please choose for the second band (nn20) B, for the third one (nn30) G and for the last one which is the near infrared band (nn40) please choose R. Your satellite image should look like the following. (Picture 37)



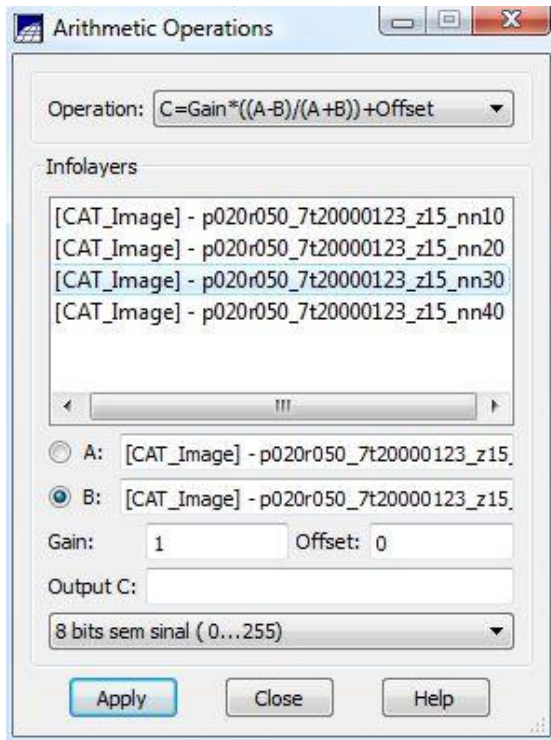
Picture 37

The window “Arithmetic Operations” just opened. There we click on the “Operation” button and select “ $C = \text{Gain} * ((A - B) / (A + B)) + \text{Offset}$.” (Picture 38)



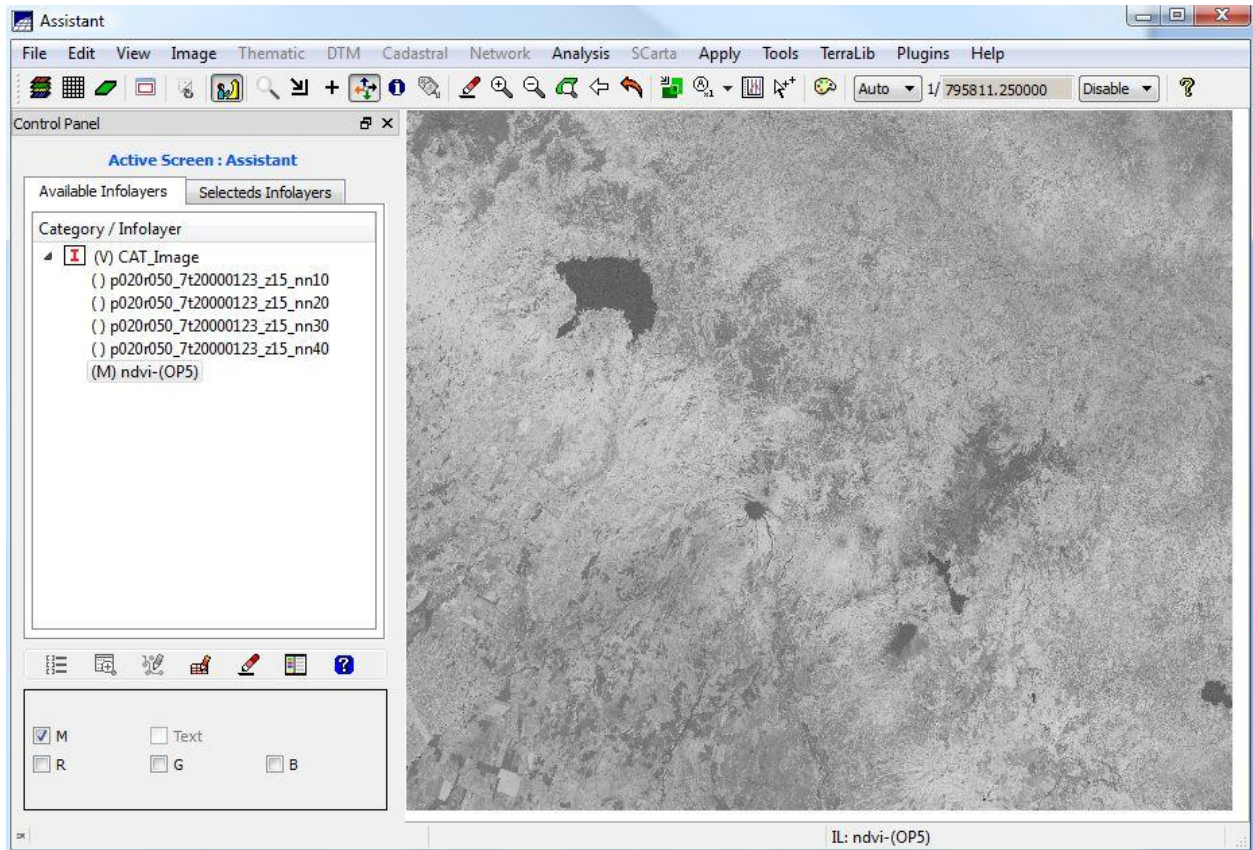
Picture 38

After that we select the band nn40 for A and nn30 for B. (Picture 39)



Picture 39

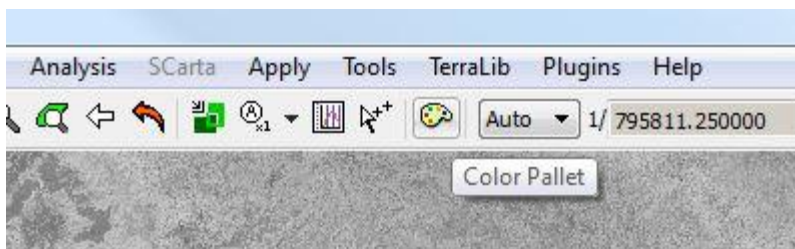
Output C can be just named "ndvi". In the dropdown menu we select 32. Finally we click on "Apply" and the NDVI will be calculated. This may take a while. When the operation is done there should be a new window called "Assistant" popping up. A new Information Layer called "ndvi" will be there, marked with an "m". You probably have to zoom in a bit. Alternatively you could close the "Assistant" window and just work in the original one. However, we should have a similar outcome as in the following picture. (Picture 40)



Picture 40

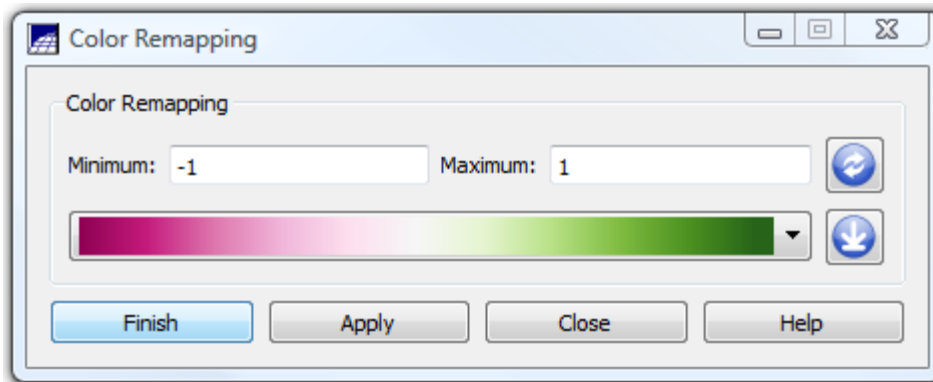
Congratulations. The NDVI is calculated. White areas symbolize regions where vegetation is active and growing, darker areas show parts where there is less, dead or not active vegetation. You can zoom in and explore a bit the data we just created. For a better reference, we can color the image by clicking on the "Color Pallet" button at the top of the screen.

-> Color Pallet (Picture 41)



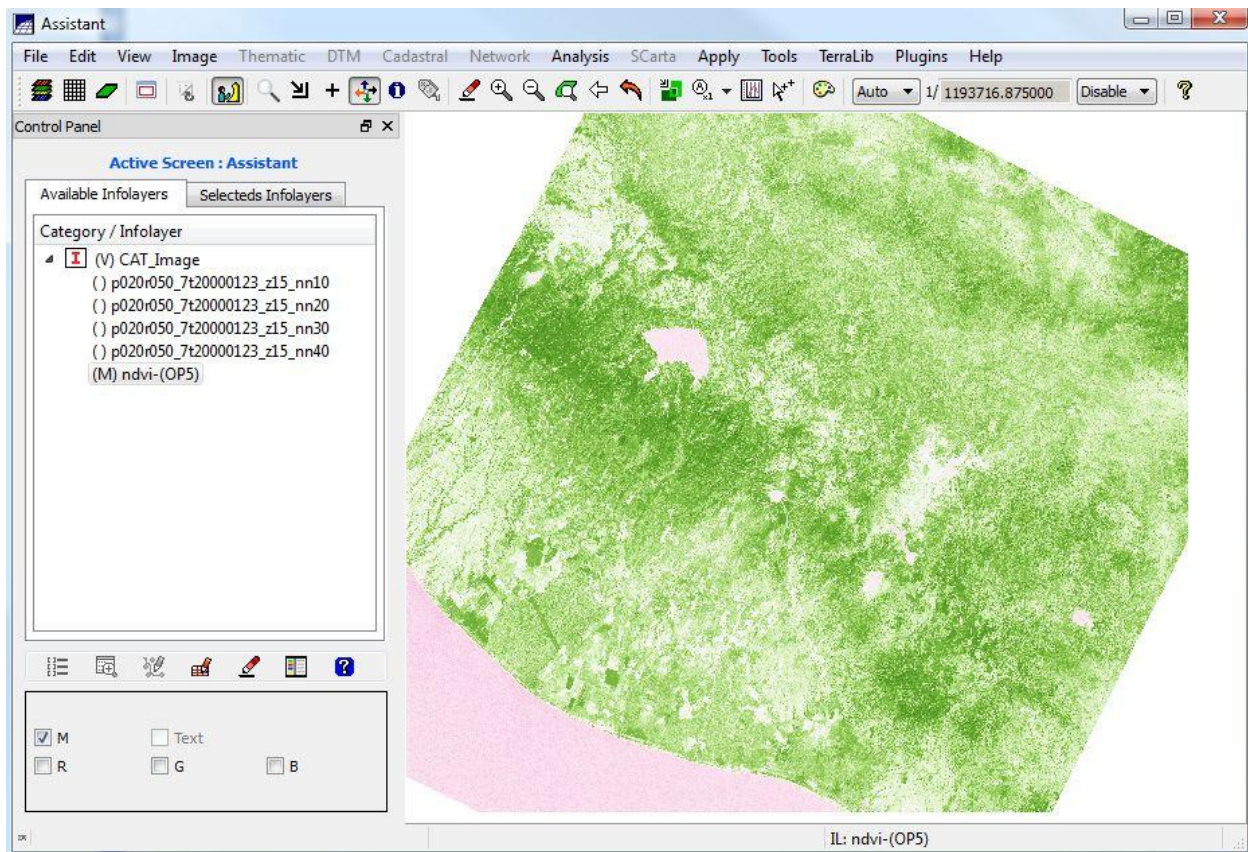
Picture 41

Select a color scale that seems useful to you. Areas with dense and active vegetation would be in dark green according to the color mapping in our example and areas with less vegetation will be marked in white or even pink. Click on “Finish” (Picture 42)



Picture 42

Our calculated NDVI image should look similar to the following one. Note that Guatemala City looks very white, as there are not many plants compared to other areas. Same applies for the big lake. (Picture 43)



Picture 43

We finally got our end result. Taking data from various dates over a large time span and calculating the NDVI out of every single one would easily show the change of vegetation cover over time and would be a helpful tool in land use change and drought monitoring.